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Civil Engineering.

Extracts from the Treatise on Geodesy, by L. B. FRANCŒUR. *Translated by* W. H. EMORY, *Lieut. U. S. Topographical Engineers.*

[CONTINUED FROM PAGE 224.]

On the Measurement of Bases.

The measurement of a distance appears the easiest of all geodesic operations, whereas, in fact, it presents the greatest difficulties when great precision is required. It is not sufficient, as in ordinary topographical operations,* to estimate the base by stepping it off, or measuring it with a chain, because the slightest error committed, rapidly increases when the sides of the triangles, composing a series, are obtained from it by calculation. When a base is to be measured, a piece of even ground is selected, which is clear and nearly level, and of about 10,000 metres, [nearly 11,000 yards,] in length. A right line is then traced on it, with stakes placed vertically in the ground. The ends of the stakes which go into the ground

* M. Moynet made various experiments in the Island of Elba, to ascertain the error from measuring with the chain, and he found an error of only 56 centimetres, [22,04776 inches,] in a base of 5165,82 metres, [about 5,600 yards.] The base was that of the Castello lighthouse.

When a sketch of a country is made in the presence of an enemy, distances are measured by pacing. The length of each pace varies with the person making it, and is determined by experiment. It is usually three feet.

Distances are sometimes measured by the report of a cannon, which travels 180 toises, [1180.25 feet,] in a second, in calm weather. This manner of estimating distances, however, is very defective.

are shod with iron, and the other ends are painted black. To facilitate the alignment the engineer makes use of a theodolite, or repeating circle, by placing it in such position that the axis of the tube of the telescope will revolve in the vertical plane passing through the stakes.

The line being established with precision, rods of a known length are used to measure it. Two rods of equal, or nearly equal length, are made use of, and the mean between them is taken as the length of each. They are placed along the stakes, end for end, and are moved in succession.

122. Wood is the material usually preferred for making these rods, as its expansion is chiefly in the transverse section, and its length is not materially increased by heat. They are preserved from the effects of moisture by being soaked in boiling linseed oil, and varnished. To prevent them from warping they are made and put together as represented in figure 68. Their precise length is known by submitting them to a standard, hereafter described. Metallic plates are fitted to each end of the rods to prevent them from chafing, and to ensure more perfect contact. Sometimes a nail with a convex head is driven in the ends of each rod, and contact is produced by bringing together these two segments of a sphere. In this case, the length of each rod is the distance between the two extreme points of the convex surfaces.

123. The rod is brought into a horizontal position by being placed on a board, shorter than itself, supported by two solid tripods. The platforms of these tripods, upon which the board rests, is elevated, or depressed, by means of prismatic rods worked by screws. The measuring rod is moved about on the board, until fixed in its position, on rollers.

When the ground is uneven, or sloping, one of the rods will be lower than the other, and the two ends are then placed in the same vertical line by being brought in contact with the delicate thread of a plumb line, the weight being immersed in water to prevent it being moved by the wind. This means of adjusting the ends of the rods is, in fact, better than the first, because it is almost impossible to avoid producing some *recoil* when they are brought in contact with each other. It is necessary, in this case, to add something for the thickness of the thread of the plumb line, a quantity apparently insignificant, but which amounts to something when repeated as many times as there are lengths of the rod in the distance to be measured.

124. There is another contrivance frequently made use of, by which the contact between the ends of the rods is easily effected. It is a small rule, called the *tongue*, which moves along two grooves cut in the rod, and is worked by means of a delicate rack and pinion. It

carries a vernier, which slides along the divisions of equal parts marked on the rod, by which the observer can read the length it is made to protrude from the rod. Then the total length of the rod will be its length as measured under the standard, plus the length which the tongue protrudes. The rods made use of to measure the bases of Melun and Perpignan, were constructed in this manner. By the aid of a magnifying glass the length of the rod can be read to the one hundred thousandth part of a toise, [.0007874 inches.] For a more detailed account of this contrivance, see *la base du Système Métrique et la Géodesie* of Mr. Puissant.

125. The improved perpendicular, or mason's level, being more convenient than the spirit level, is made use of to adjust the rod in a horizontal position. The sides A C, A B, are of equal length, and form an isosceles triangle A C B, and are kept in position by the metallic arc *a* E *b*. An alidade C D, carrying a vernier, is suspended from the centre C of the arc, and revolves about it. The arc is divided into degrees, and by the aid of a vernier a minute can be read upon it.

A spirit level *c f* is fixed perpendicularly to the alidade, upon which equal divisions are traced and numbered from the centre, by which it can be seen when the bubble is in the centre. The zero of the graduation of the arc *a b* is also at the centre E of the arc.

The instrument is so constructed that when placed upon a horizontal plane A B, the alidade is at the zero point of the graduation, and the bubble is in the middle of the glass. When it is turned end for end the same conditions should be fulfilled.

Something might be said of the tangent screw attached to the alidade, and other details in the construction of the instrument, but they can be easily imagined. If, however, a more detailed description is desired, it can be found in vol. ii, p. 9, of the *Système Métrique.*

126. As much time is lost in levelling the rods, it is better, when the inclination does not exceed two or three degrees, to leave them as they are, and measure the inclination, and then reduce the rod to the horizon by calculation, that is, calculate its projection on a horizontal plane. The inclination is measured by reading the graduation indicated by the alidade, then turning the level end for end, and reading the indication in this position also. Half the sum of these indications is the inclination of the rod.

127. *The reduction of the rods to the horizon.*—Let C B (fig. 56,) be the rod, C A its horizontal, and A B the vertical projection, and θ the angle of inclination. Knowing A B, and the angle C, we can find the sides C A, A B. The triangle A B C gives C A = C B cos θ. But θ is a very small angle, and the value C A cannot be calculated

with sufficient precision; we therefore obtain it by finding the excess (x) of C B over C A. x = C B—C A; and we have $\cos \theta = 1 - \frac{1}{2}\theta^2$, nearly, from which we get C A = C B $(1 - \frac{1}{2}\theta^2)$ and by calling C B = L, we get $x = \frac{1}{2} L \theta^2$. Now by substituting for the arc θ its value expressed in its number of minutes we have

$$x = -\frac{1}{8} L (2\theta)^2 \sin.^2 1' = -P L (2\theta)^2.$$

P being substituted for the constant $\frac{1}{8}$ sin.^{2} 1′. In the same manner we find for the difference in height A B,

$$y = L \sin. \theta = \frac{1}{2} L (2\theta) \sin. 1'.$$

The levelling instrument makes known the angle 2θ by turning it end for end, and taking the sum of the inclinations, and the calculations are very easy. The logarithm of the constant P = 8.0243622; and log. $(\frac{1}{2} \sin. 1') = 4.1626961$. The arc (2θ) is expressed by its number of minutes.

The calculation is much abridged by constructing tables giving the values of x and y for every inclination (2θ) of the rod.

128. *Correction for temperature.*—When the rods are metallic the change of temperature in the morning and evening produces a change in the length which must not be neglected. The temperature of the rods is noted at those times when there is the greatest variation, and the mean between these extremes is assumed as that of the rods for the interval which elapses between the two observations. For the purpose of noting these changes a thermometer is sunk in the rods.

In the rods used for the French triangulation the thermometers were metallic, and fitted to a brass rule, which slid lengthwise into the rods, and were held there by two grooves. One of the ends of the rule forming the back of the thermometer was fastened to the rod by a screw, or by soldering, while the other was free. As the metals of the rods and thermometers were different, one being of platinum, and the other brass, their expansion was not the same for the same variation of temperature. At a certain degree of temperature, two marks, one on the rod, and the other on the thermometer, coincided, and they ceased to do so as soon as the temperature changed. By the aid of a magnifying glass, and divisions of equal length marked on the metal, the observer was enabled to read the excess of expansion of one metal over the other, and consequently the variations of temperature. The degrees of temperature were marked on the thermometer, and could be read with facility. The manner of calculating the lengths corresponding to the changes in temperature will presently be explained.

It was important that the rods should be sheltered from the sun, and for this purpose a kind of wooden roof was placed on the levelling

boards, with vertical sights at each end by which the rods were placed in the required direction.

To avoid errors, each reading of the tongue, the metallic thermometer, and of the inclination of the rods, is made twice. The results are noted in two separate books, and compared before proceeding to a new measurement.

129. *The measurement of the rod by the standard.*—To determine the exact length of the rods it is necessary to compare them with some other known length. For this purpose, an instrument called the *comparing rod*, is used, which, by magnifying them, shows the smallest differences in length between two rods placed one on the top of the other, and abutted at one extremity against a fixed point. For a detailed description of this instrument see the *Système Métrique*, vol. iii, p. 464. In obtaining the length of rods by this standard, the nature of their substances, and their temperature, must be taken into consideration.

131. It has been ascertained that for a change of 1° of the centigrade the length of the rod varies a quantity a, shown by the following table.

Platinum, - - -	$a = 0.0000085655$
Brass, - - -	$a = 0.0000187785$
Wrought iron, - -	$a = 0.0000122045$
Steel, not tempered, -	$a = 0.0000107915$

This is called the linear expansion.—Thus a metre of brass, in undergoing a change from 0 to 100°, is increased in length $0.^{m}00187785$, or nearly two millemetres, [0.07874 inches English.) This is a quantity too large to be neglected.

Suppose l to represent the length in metres, toises, feet, &c., of a metallic rod at a given temperature. If the thermometer shows t number of degrees, (centigrade,) we have the elongation for every unit of measure by the proportion $1° : a : t : at$, a being the elongation for one degree taken from the table. Thus the length corresponding to t degrees is increased $a\,t\,l$, and becomes

$$L = l(1 + a\,t) \quad . \quad . \quad . \quad . \quad (1)$$

131. First Case.—When the rod is of wood, and the standard of metal, we commence by calculating the length L of this standard for the actual temperature, knowing its length l at zero. The number denoting l is usually engraved on the standard. Then if the wooden rod is made of the same length as the standard, L will express its length. If it is not the same length, the difference is shown by means of the apparatus of comparison, and this difference added to, or subtracted from

L, gives its length, which, as we have before observed, is invariable. The number denoting the length is then inscribed on the rod.

SECOND CASE.—If the rod and standard are both of the same metal there is no calculation to be made. If they are also of the same length, l, that of the standard at zero is engraved on the rod. When they are of different lengths, the difference δ is measured by the comparing apparatus, and $l + \delta$ is then the length of the rod at zero. In this case the actual temperature is not considered.

THIRD CASE.—We suppose the rod and the standard of different metals, and cut to the same length at a certain temperature t. When the temperature of the standard is reduced to zero its length becomes l, and the rod becomes of an unknown length x, which it is required to find. By equation (1,) we know in a change of temperature from 0 to t degrees centigrade the length of the standard and the rod will become:

For the standard, - - - $l\,(1+\alpha t)$,
" rod, - - - - $x\,(1+\alpha' t)$

α and α' expressing the linear expansion for a unit of measure in the two metals respectively. As both rods are then equal, we have

$$l\,(1+\alpha t) = x\,(1+\alpha' t)$$

from which we get

$$x = l\left(\frac{1+\alpha t}{1+\alpha' t}\right)$$

By developing this equation, and neglecting the terms of the second order, we have for the length of the rod at zero,

$$x = l\,[1-(\alpha'-\alpha)\,t] \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Its length at any given temperature t' of the centigrade will be

$$l' = x\,(1+\alpha' t') \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

and if the rod is not cut exactly the length of the standard its length will be $x+d$; d being the difference of the two.

This value $x+d$ is the one marked on the rod, and is that given to x in equation (3). When a line is measured with this rod, under a temperature t', given by the centigrade thermometer, it is necessary to calculate its length l' by equation (3), α' being the constant corresponding to the metal used.

132. This method is subject to the inconvenience of giving a value to l' (the length of the rod,) containing a fractional expression, because the length of the standard l is a whole number, (usually four metres.) To reduce this to an expression containing no fractions, it would be necessary to diminish the rod by a quantity equal to $(\alpha-\alpha')\,tl$, and then at zero it would be of the same length l as the standard. But as this diminution would be difficult to make, and as an addition would be impossible, the following expedient is resorted to.

Suppose that the rod and the standard at a given temperature t are of the same length, namely, $L = l\,(1+\alpha t.)$

When the temperature falls to T, that is to say, decreases t—T, the rod will diminish $L\,\alpha'\,(t—T,)$ and its length will be

$$L\,[1—\alpha'\,(t—T)\,] = l\,(1+\alpha t)\,(1—\alpha' t+\alpha'\,T.)$$

Now find what should be the temperature, in order that the rod may be of the same length l as the standard at zero. To do this make the above value equal to l, and by neglecting terms of the second order we have

$$\left.\begin{aligned} \alpha'\,T &= (\alpha'—\alpha)\,t, \\ T &= \left(\frac{\alpha'—\alpha}{\alpha'}\right)t = \left(1—\frac{\alpha}{\alpha}\right)t \end{aligned}\right\} \quad . \; . \; (4)$$

The length of the standard l is then marked on the rod, and also the temperature T, at which the rod assumes this length.

To get the length l' of the rod at any other temperature, equation (3) is used. In this case t' is the excess of the actual temperature over T.

133. Suppose, for example, that the standard is of platinum, and is five metres at zero, and that the rod is of brass, and cut the same length when the thermometer is 100°. We have then $l = 5$, $\alpha'—\alpha = 0{,}000010213$, and the length of the rod at zero will be $x = 4.^{m}99948935$. If we find any inconvenience from making use of this fractional number, ascertain under what temperature the rod is five metres in length. Suppose it to be $T = 5°{,}44$, we then mark on the rod five metres and 5°,44. The result, of course, will be the same in either case.

Now suppose we have ascertained a distance to be 2000 times the length of the rod just described, the temperature being 18°, we can find the total distance in two ways, either by making equation (1), $l = 4.^{m}99948935$, $\alpha = 0{,}0000187785$, and $t = 18$, or by taking equation (3) and making $l = 5$, $\alpha =$ the same number, and $t' = 12°{,}56$, the excess of 18° over $T = 5°{,}44$. These methods both give $L = 5.^{m}001179$, thus a base of 2000 times this rod $= 10002.^{m}358$. If the rod was taken as five metres, regardless of expansion due to the metal, it is evident that the very considerable error of $2.^{m}358$ would be committed in the measurement of this distance.

134. *The reduction of a broken base to a right line.*—It is desirable always that the base should be one unbroken right line; but it is not always that ground can be found running in a direct line, and nearly horizontal, for a distance of some 10,000 metres. We are then obliged to measure the length indirectly. This was the case in the measurement of the bases of Melun and Perpignan.

Suppose A B C to represent the broken line, or base, and that we know the lengths A C, C B, and the angle $\theta = 180°—C$, which we

suppose to be nearly 180°. θ = B C 1, and making A C = b, B C = a, it is required to find A B = c, which is to be regarded as the measured base. We have*

$$c^2 = a^2 + b^2 + 2\,ab \cos.\,\theta$$

and by making $\cos.\,\theta = 1 - \frac{1}{2}\,\theta^2$, neglecting the fourth powers of θ we have

$$c^2 = (a+b)^2 - ab\,\theta^2,\ c = (a+b)\left[1 - \frac{ab\,\theta^2}{(a \times b)^2}\right]^{\frac{1}{2}}$$

and by developing the power $\frac{1}{2}$ as far as the terms of the second degree, and designating by θ the number of minutes in this arc, we have

$$c = a + b - \frac{ab\,\theta^2 \sin.^2 1'}{2\,(a+b).}$$

When the signal at B cannot be seen from A, and the signal C can be, it is necessary to know the angle A, as the neighbouring points which are measured in relation to A C should be referred to the base A B.

We have $\frac{\sin.\,A}{\sin.\,\theta} = \frac{a}{c}$, and $\sin.\,\theta = \theta - \frac{1}{6}\,\theta^3$

from which we get

$$\sin.\,A = \frac{a\,\theta}{c}(1 - \tfrac{1}{6}\,\theta^2)$$

and by substituting for c its value given above, we have

$$\sin.\,A = \frac{a\,\theta}{a+b}\left[1 + \frac{ab - a^2 - b^2}{6\,(a+b)^2}\,\theta^2\right]$$

Now (see trigonometry,) arc A = sin. A + $\frac{1}{6}$ sin.^{3} A, and substituting for sin. A its value, and then changing the small arcs A and θ into A sin. 1′ and θ' sin. 1′ to express them in minutes, we have

$$A = \frac{a\,\theta}{a+b} + \frac{ab\,(a-b)\,\theta^3 \sin.^2 1'}{6\,(a+b)^3} \quad \ldots\ldots \quad (6)$$

135. *Reduction to the level of the sea.*—The difference between the elevation of the two extremities of the base are known by calculation, and if we suppose the base to be turned about its middle point until one end is depressed as much as the other is raised, the base may be regarded as an arc of a circle with slight curvature, having its centre at the centre of the earth. Suppose A A′ is this arc = B, the length of which is known; and that $a\,a'$ is the concentric arc described on the level of the sea: Ca = K the terrestrial radius, or the normal

* The triangle A B C is spherical, but is reduced to a right line triangle by subtracting from the observed angle C the third of the spherical excess, and taking the remainder for the value of C. In fact, a base is a line of double curvature, but we consider the earth as spherical, and the arc as being that of a circle contained in a vert cal plane. The error from this supposition is inappreciable.

to the surface, $Aa = h$ the height of the extremities of the base above the level of the sea.

It is required to find the arc $a\,a' = b$, which is the base B reduced to the level of the sea. The plexus of geodesic triangles is projected on the surface of this level, and it is therefore necessary to project the base upon it also. The length B is, in fact, measured upon the arc of a circle, because the horizontal direction, perpendicular to the normal, is constantly preserved either by mechanical means or by calculation. The manner of obtaining the height $Aa = h$ will soon be shown; it is the elevation of the middle point of the base above the sea.

We have the proportion C A : Ca : A A' : $a\,a' = b$

$$b = \frac{B\,R}{R + h} = B\left(1 - \frac{h}{R^2} + \frac{h^2}{R^2} - \&c.\ .\ .\ .\right);$$

as R exceeds six millions of metres, (nearly seven millions of yards,) and as h is always very small the series is converging, and we can, in almost every case, take the two first terms $B - \frac{Bh}{R}$. Thus to reduce the base to the level of the sea it is necessary to subtract $\frac{Bh}{R}$.

136. We have now given an account of the operations and calculations necessary to obtain a geodesic base. It is the most delicate of all geodesic operations, as the accuracy of all other results depends upon it. The utmost care is therefore necessary in all the details of its measurement. To give an example of the great accuracy it is possible to attain, we will instance the measurement of the bases of Melun and Perpignan, measured by Delambre and Méchain, the first near the road from Paris to Melun, and the other from Vernet to Salces.

The base of Melun, after the corrections were made, and it was reduced to the level of the sea, was found to be 6075,90 toises; and that of Perpignan 6006,249 toises.

The distance between these bases was considerable, and they were connected by a chain of sixty-three triangles of the first order. By the aid of formulas, which will be given hereafter, one of these bases was calculated from the other, and the result was as follows:

Base of Perpignan, measured, was	6006.249	(13135.6665 yds. Eng.)
" " calculated,	6006.089	
Difference,	0.160	

Thus the error is only 0,16 of a toise, or 11.52 inches, (12.55 inches English,) a quantity scarcely worth noticing. This coincidence, however, is no doubt attributable to the compensation of errors, as the

chain of triangles from Orleans to Bourges was found defective in the verification it was subjected to when the chain for the *meridian* of Fontainbleau was measured. The error was confirmed by another lateral line to the west of the first.

These results, then, are not cited to show their exactness, but rather as examples of the care necessary to be taken.

Seven bases have been measured in France, and compared with each other, by connecting them with a chain of triangles. The results will be given hereafter. The errors are so small that they may be attributed to causes which will be assigned hereafter, rather than to the imperfection of the operations themselves. These magnificent works are in the highest degree honourable to the able engineers entrusted with their execution. For a comparison of the base measured on the Bordeaux Heaths, with that measured by Oriani, near the Tession, see the *Nouvelle Description Géométrique de la France, p.* 458.

TO BE CONTINUED.

Notes on Belgium. By CAPTAIN G. W. HUGHES, *United States Topographical Engineer. Addressed to* FRANCIS MARKOE, JR., ESQ., *Corresponding Secretary of the National Institution, Washington.*

[CONTINUED FROM PAGE 232.]

Our next visit was to Fontaine l'Eveque, about seven miles from Charleroi, up the Sambre, the seat of the nail factories of the Province of Hainault. There are about 5000 persons employed (during the winter,) in the fabrication of nails; but not more than forty of this number are connected with the machines, all the others being occupied in forging nails by hand. The machines used here are an American invention, and exact copies of Judge Pierson's, which may be seen in operation at the Ramapo works, New York.

It requires much better iron for cut than for wrought nails, and it is asserted that, as it regards the larger sized nails, the iron plates, adapted to the machine, cost more than the same weight of wrought nails. This will explain the reason why so many persons are engaged in the slow operation of forging them by hand. It must also be remembered that wages are extremely low, and that, of course, labour-saving machinery is less important in Belgium than in most other countries. An agricultural labourer receives only 1fr. 10 centimes a day, or about twenty cents of our money, and finds his own subsistence. When the severity of winter drives these people from the fields they engage in nail making, at probably no higher rates of wages.

The "Clouterie à la Mecanique," or manufactory of nails by machinery, also belongs to an anonymous company, under the patronage of a bank, and is in charge of a director, Mr. D'Haussy, by whom we were most kindly entertained. It consists of thirty machines, making as many different sized nails, put in motion by an engine of thirty horses power, which is competent to the working of sixty machines, the whole number of which the director calculates will be soon put in operation. Each machine makes 120 nails per minute, every revolution cutting and heading one nail. It requires no other attendance than simply *feeding* it with iron, which it seems to *eat* with as much avidity and gout as an anaconda exhibits in gorging its prey. There is, however, another American nail machine, far superior to the one now in use, which makes a better nail, and cuts, it is said, from 600 to 1000 per minute. It is called "Hunt's Patent," after the inventor, an ingenious mechanic of New York.

There are something more than 12,000 tons of nails fabricated annually in Belgium; of which about one-fourth part are exported.

The following extracts from the printed tariff of prices will show their sizes, prices, &c.

No. of thousands to the ounce.	Price per thousand	Price per kilogramme.	
		Dollars.	Cents.
3	30 centimes.	3	42
6	34 "	1	93
12	42 "	1	19
16	48 "	1	04
32	71 "	0	75
96		0	56

The next day we turned our attention to the glass and chemical works at Oignies, about nine miles from Charleroi, on the road to Fleurus and Ligny. This establishment occupies the buildings and former site of Oignies, a Monastery of learned Augustine Monks, which was suppressed by the French revolutionary army, and the property confiscated to the state. Very extensive buildings have been added to the old monastery, and these works now cover an area of thirteen English acres. They belong to an anonymous society,

with a capital of 10,000,000 francs, under the patronage of the *Societé générale de Belgique.*

Mr. Kemlin, the highly intelligent director, conducted us over these works, and was at much pains to show, and to explain to us, even the minutest details connected with this vast establishment.

The director led us first to the chemical department, which may be regarded as a grand laboratory, where operations are carried on, almost, on the scale of nature. Our attention was drawn to the formation of sulphuric acid in the large way. The first process is to procure the sulphur, which is obtained from iron pyrites, a material sufficiently abundant in most coal measures. This mineral, or *mundic*, as the British miners call sulphuret of iron, is washed, ground to powder, and dried. It is then put into furnaces, and the sulphur, expelled by heat, is conducted into large leaden chambers. During its transit it combines with oxygen, forming the sub-acid or sulphurous acid gas. To still further oxygenate it nitric acid is used. This is liberated from the nitrate of potash, and passed into the leaden chambers at the same time with the sulphurous acid, by which it is decomposed—the oxygen uniting with the sulphurous acid forming sulphuric acid, and the nitrogen escaping free.* The sulphuric acid is then passed through several leaden chambers containing water, by which it is absorbed. 2,000,000 kilogrammes, or more than 4,000,000 lbs. of this acid are made here annually; and it sells for $4 the French quintal, (of 100 kilogrammes,) which is the usual measure of sale, and is equal to 220½ lbs. English.

We next saw the manufactory of sulphate of soda. It is obtained from a substance called *marine salt*, (which term, I understood from the director, is applied to a mixture of the sulphates and muriates of soda, separated from the other salts contained in sea water.) This article is admitted free of duty, at the Custom House, but is *poisoned* to prevent its use for domestic purposes. This salt is placed in a furnace, and the muriatic acid is expelled in a gaseous form, and passed through a great number of large earthen retorts connected together with bent tubes of the same material. These retorts are partly filled with water, which absorbs the gaseous acid, forming hydrochloric acid. Of this there is made annually about 500,000 kilogrammes, or 1,100,000 lbs., which sells for about fifty cents the 100 lbs. A portion of it is passed over quick lime, forming the chloride of calcium.

The sub-carbonate of soda, so much employed in soap and glass making, is formed by taking a mixture of sulphate of soda, carbonate of lime and charcoal, and calcining them together in a furnace. During the calcination a double decomposition takes place, and the pro-

* It is necessary to remind our readers that the theory of the formation of sulpuric acid is by no means so simple as is here supposed.—Com. Pub.

ducts are a mixture of sulphate of lime, (insoluble,) and sub-carbonate of soda, (soluble.) These substances are separated by the action of water, which takes up the soda and leaves the lime. This residuum is used as a manure. The solution is now boiled down, and the salt obtained in a crude form. It is then again dissolved, evaporated by boiling, and kiln dried, forming the ordinary sub-carbonate of soda of commerce. When it is desirable to obtain it of a very pure character it is once more dissolved, and then left in vats to crystalize, on strings placed in the fluid for the purpose.

A portion of this salt is sold, and the rest is employed in the glass works. The annual production is about 2,000,000 lbs., and it sells for $6 50 cents the 110 lbs., or $13 the French quintal.

There are 250 persons employed in this department; the men receive two and a half francs a day, and the women and boys from seventy-five centimes to one franc a day.

Our next visit was to the glass works—they are exclusively devoted to the fabrication of looking glasses and very large plate, window and door glass, of the better quality.

Glass is made from the fusion of a mixture of sub-carbonate of soda and sand. The sand is very nearly pure silex, as white as snow, and very fine. It is brought from the Ardennes, where it occurs in beds forty feet thick. It is worth from one and a half to two and a half francs the French quintal, or 220½ lbs. English. It is washed, to separate the earthy matter from it, and kiln dried.

The proportions of sub-carbonate of soda and clean sand, entering into the composition of glass, are variable, depending on the quality of the former. When it is very good, the mixture is *one part* soda and *three parts* sand—when inferior, it is mixed with equal quantities of sand. This mixture is melted in furnaces, somewhat resembling, in appearance, blast furnaces, but not so large. Coal is used as the fuel. In furnaces of the most approved form the mixture may be fused in fifteen hours, but in others it requires, for this operation, twenty-four hours. The broken fragments and clippings of glass are re-melted.

The melted glass is run into large argillaceous tubs, by which it is conveyed to an iron table, about twelve feet long and seven feet broad, on which it is poured; and while still soft, an iron roller, about one foot in diameter, is repeatedly passed over it. As soon as the plate becomes solid it is placed to cool slowly, in a low, flat, arched receptacle, which is closed up, and the plate is left here twenty-four hours. When taken out, it is scarcely translucent, and seems to be covered with large, slightly convex blisters, and its edges are uneven, and sometimes defective, for several inches in width.

The tub by which the melted matter is carried from the furnace to the table is called a *cuvette*, and is made from a dark blue clay, found near at hand. This clay is nearly pure alumine, and when baked by a slow fire, (after having been prepared for the purpose by washing, grinding, etc. etc.,) it is sufficiently hard to strike fire from steel.

The crude plate is now carried to the rough polishing house. In this house are eight large smoothly-polished marble slabs, each rather larger than the iron table, solidly laid in mortar, on brick foundations. These slabs are covered with a gypseous paste, and the glass plate, fastened to an iron frame moved by steam, is ground on the marble by a species of circularly rubbing motion. Presently it is fixed to the slab, and its upper surface is rubbed in a similar manner. It is then transferred to other slabs, where two slabs are ground together by machinery, with fine sand between them, and jets of water continually playing on them. Next they are ground, in the same way, with emery instead of sand, till their surfaces are nearly uniformly smooth. They are now carried to another house, where they are ground together by hand, with nothing between them, till they are perfectly smooth. They are then fixed on a table to be polished. The polishers are made of coarse felt, fastened to iron frames, moved by steam. The substance used for this purpose is a *crocus*, obtained from an ochrey red oxide of iron. After being rubbed on both surfaces till it is supposed the plates are perfectly polished, they are removed to the finishing room, where they are carefully rubbed by hand, for the last time, with crocus.

The next operation is the cutting of the glass to the required dimensions, (for it is always cast large.) This is done with a diamond, and a single line, seeming scarcely to penetrate the surface, is sufficient even for the thickest glass. A slight, quick blow, from below, completely separates the parts, leaving the edges perfectly smooth.

The finishing process for mirrors consists in the application of the amalgam. As much mercury is poured on the table as the tin leaf can be made to take up, and the glass is then forced over the amalgam, beginning with one edge, and removes before it the surplus mercury. This requires some care and skill, especially with a large glass. The director is making arrangements to cast a plate (for a mirror, to be exposed at the coming "exhibition of industry," at Brussels,) the size of the iron table recently cast for that purpose at Couillet. The price of this large mirror will be, according to the tariff, some $ 2,500. The largest which has, as yet, been sold at these works brought 9,835 francs. It was 150 inches × 100 inches. It would require eight days to finish one of these very large glasses if they should work on it uninterruptedly for that period.

One hundred and fifty persons are employed in this branch of the establishment, and arrangements are being made to enlarge the buildings, and increase the number of employees, as a ready sale is found for all the glass they can make. The only difficulty is to secure the services of skilful workmen; who can earn from five to seven francs a day, (very high wages,) according to their knowledge and industry.

The Sambre passes directly under the walls of Oignies, and affords a convenient communication with Charleroi and Namur. It is called "*une riviere canalisé*," or a *canal-ized* river, which expresses the meaning much better than our term "slack water navigation;" and might be adopted into our language with some advantage.

In company with Mr. Meeas we visited a manufactory of sugar, from the beet root, belonging to a company called the *Raffinerie Nationale*, of which he is the president. The estate of this association consists of three large farms of 1,800 acres of rich land, and is devoted, primarily, to the cultivation of the sugar beet, but the corn is also grown, in order to preserve a certain alternation of crops. In connection with this main object they raise large numbers of stock, which are fed on the pulp after the saccharine matter has been expressed, and this yields no small amount of their dividends. The farms are kept in admirable order, and the buildings are very extensive, well arranged, and well built. Order and good management seem to reign everywhere under the admirable administration of its enterprising president.

The capital of the company is 4,000,000 of francs paid in, together with the application of the dividend, for the last two years, to the improvement of the works.

The annual production of sugar and gin is sold for about 200,000 francs. The wholesale price of sugar is eighty francs the French quintal, (of 100 kilogrammes,) and of gin, fifty-six centimes the litre, (about three pints English.)

The average crop, in good seasons, is about 14,000 kilogrammes, or fourteen tons English to the acre, which is worth sixteen francs the ton, or about $44. The root, most in favour, is the Siberian, which requires a rich sandy loam, and a good deal of moisture, but the labour, per acre, is much less than that usually expended on the cultivation of tobacco.

It is said that the beet root possesses rather more saccharine principle than the same weight of cane; but thrifty housewives say that the sugar from it will not *go so far* for domestic use; and it is not so good for the preservation of *fruit*, as it causes the *sweet meats* to ferment.

The refinery is situated between Waterloo and Mont St. Jean, to

the left of the road to Quatre Bras. The buildings of this establishment cover some ten acres of ground, and are exceedingly well arranged. We were taken through every portion of it, and spent nearly the whole day in its examination; but as the subject is one that cannot be disposed of in the short limits of a paper, I shall not attempt the subject at present.

This estate extends to "the field of Waterloo;" and from the refinery we had a magnificent view of the lofty *lion monument*, which marks the spot where the Prince of Orange was wounded. In looking round on the soft landscape, the peaceful villages, and the fields rich with waving corn, I could not but recall to memory the beautiful and touching lines of Southey, so descriptive of the effect produced on my own mind in contrasting the fury of the battle with the air of repose which seems to pervade the locale of that bloody strife.

"Was it a soothing or a mournful thought,
Amid this scene of slaughter as we stood,
Where armies had with recent fury fought,
To mark how gentle Nature still pursued
Her quiet course, as if she took no care
For what her noblest works had suffered there."

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On Cast Iron Rails for Railways. *By* Ellwood Morris, *Civil Engineer.*

We are informed in Wood's treatise upon railroads, that in the early part of the seventeenth century, railroads were first used in England, and they were then formed of wood; *the wooden rails* were employed for about 100 years, when in 1767, *cast iron rails* were first introduced, and thereafter continued for a period of near fifty years, to be used instead of any other material; but in the year 1815 *malleable iron edge rails* were devised, and after Mr. Birkenshaw, in 1820, had obtained his patent for an improvement in the form of such rails, and applied the rolling mill to their manufacture, they were very extensively adopted, and subsequent to that period of time have been almost exclusively used; indeed, since the modern improvements in the means of intercommunication by railways have enabled locomotive steam engines to travel at velocities of thirty miles and more, per hour, the use of *cast iron rails* has been, for the present, laid aside, if not wholly abandoned, on public railways.

The chief reasons which seem to have induced engineers, both here and abroad, so much to prefer *malleable* before *cast iron rails*, as to exclude the latter from use, appear to have been, originally, a belief that,

1. Malleable iron rails were cheaper than those of cast iron.

2. Malleable iron rails being made in longer lengths caused fewer joints.

3. Malleable iron rails were less liable to fracture from concussion.

4. Malleable iron rails were thought to be somewhat more durable.

Although these reasons are very plausible they have nevertheless been found not to be valid in practice to the full extent that was anticipated by those who fostered them, and with regard to them it may be observed,

I. With respect to the comparative economy of cast and malleable iron rails, it is certain that the latter, in this country at least, are not cheaper than the former, and if made of American rolled iron instead of imported, they would be much more costly.

II. Convenience of handling seems to have fixed the length of wrought iron rails at about fifteen feet, and of this dimension there is but little difficulty either in moulding or casting rails; but it is very questionable whether sufficient practical advantages do not attend cast iron rails of six or ten feet length, to induce a preference to be given to them over others of greater lineal extent.

III. It is unquestionably true that *malleable iron rails* are far stronger than *cast iron* ones of the same dimensions, when exposed to *a direct impulsive force;* indeed, we find it stated in Tredgold's essay on the strength of metals, "that a velocity, (direct,) of $17\frac{6}{10}$ feet per second, or twelve miles per hour, would break a beam (of cast iron;) or a beam would break by falling from a height of five feet!"

Now if any such force was actually brought to bear upon the rails of railways in practice, it would, of course, be improper to employ those of cast iron, but happily this is rarely, if ever the case, for although Tredgold's statement may be true, when a weight *falls directly* upon a cast iron beam; no such result would ensue from *oblique impact*, with the same momentum that would be generated in the supposed case; and as the concussions produced upon a railway by a train at speed are of the latter character, it becomes necessary to inquire what vertical stress, or pressure, imposed by the wheels, results from their *oblique impact* when in rapid motion upon the rails?

A little reflection will satisfy any one that the impact upon the rail of a carriage wheel running at high speed, is a very different affair from the concussion produced by a weight falling freely; for instance, if an engine with a velocity of thirty miles an hour passes over a rail which, at the joint, is $\frac{1}{10}$ of an inch higher than its neighbour, the wheel would advance in the air without touching the rail for the space of *one foot;* for, by gravity, "a body requires $\frac{1}{44}$ of a second to fall $\frac{1}{10}$ of an inch, and in that space of time a wheel running at the

rate of thirty miles an hour would move horizontally forward *one foot;*" in such a case, then, the wheel may be regarded as having traversed in the air an inclined plane, of which the base would be 120 times the altitude, and consequently if the force of impact be resolved by the parallelogram of forces, into two others, one perpendicular to the rail, and the other parallel to it, the former will be not quite the $\frac{1}{120}$th part of the whole impulsive force, instead of being equal to it, as would have been the case if the stroke were direct, or if the engine had fallen freely by the action of gravity alone through the vertical space of $\frac{1}{10}$th of an inch, and the percussive force upon the rail, produced by a free fall through even that small height, would far surpass that which would be created by the $\frac{1}{120}$th part of the oblique momentum of the wheel at the pace of thirty miles an hour.

This reasoning leads us to the conclusion that in such cases the greater the velocity of the engine the less will be the vertical pressure of the wheel upon the rail, and this, to a certain extent, is undoubtedly true, for the horizontal component of the force of impact will be greater than the perpendicular one, just as the velocity is greater.

Upon the same principle it is, that a musket ball shot parallel along a horizontal plane, so as to barely touch it tangentially, will not press upon the plane at all within the limits of its level or point blank range.

Whether these views agree or not, with those commonly entertained concerning fast trains on railways, they are, nevertheless, legitimate deductions from the established doctrine of forces, and serve to account for the small effect produced by the ordinary inequalities of a railroad, as shown in the results displayed by the following direct experiments touching this matter, which were made by Professor Barlow, and recorded in his work on the "strength of materials," English edition, 1837; these experiments are conclusive in their character, and establish, beyond question, the fact, *that the vertical stress imposed upon a railway by the transit of locomotive engines at velocities varying from twenty-two to thirty-two miles an hour, is but little, if any, in excess of that produced by a quiescent load of the same weight!*

These experiments by Professor Barlow, were made with an ingenious and accurate instrument, to determine the deflection of rails under trains running at high speed, and as the deflection of materials under a strain, is as the insistent weight, the vertical pressure upon the rails is by this means accurately indicated.

Experiments.

	Deflection in inches of the rail in the middle length.
1. Speedwell engine and train at twenty miles an hour, weight upon the driving wheels nearly six tons, or three tons on each wheel. - - - - =	.0425 .0400 .0400
2. Ditto same speed, - - - - =	.0320 .0400 .0420
3. Ditto very slow, - - - - =	.0240 .0250 .0320
	9).3175
Mean deflection in these experiments, inclusive of the yielding of the stone block supports, - =	.0353

Now, by trials made with direct pressure, upon the same railway bars which were travelled over by the trains in the above experiments, and then taken up and forwarded to Woolwich, for the purpose of examination, Professor Barlow states that the mean deflection, under a load of three tons weight at rest, was - - = .0314

Whilst the mean deflection, under trains in motion, at velocities as high as twenty miles per hour, as stated above, amounted to - - - - = .0353

Difference, - = .0039

which, when we consider that a portion of this difference is due to the depression of the blocks, indicates "a close agreement, which shows, that when every thing is well fixed and secure, the deflexion, and consequently the strain, is nearly the same, whether the load be *in motion or at rest;* and that each rail is only pressed with half the weight on one pair of wheels."

The rail tried in the preceding experiments, was that of the Grand Junction Railway, weighing sixty-two pounds per yard, and laid with three feet nine inches bearing; in those following, Professor Barlow employed the same pattern of rail, but laid with bearings five feet asunder.

Experiments.

	Deflection in inches of the rail in the middle length.
1. Swiftsure engine, velocity twenty-two miles an hour, three tons weight on each driving wheel, - =	.093 .077 .080

2. Ditto same speed, - - - - -	=	.082 .070 .077
3. Speedwell engine, velocity thirty miles an hour,	=	.112 .091
4. Ditto, velocity thirty-two miles an hour,	=	.122 .115
5. Fury train, velocity twenty-three miles an hour,	=	.083 .085
		12)1.087
Mean of these experiments, inclusive of the yielding of the stone block supports, - - - - -	=	.090

In experiments made at Woolwich, with vertical weights at rest, upon the same rails, the mean deflection produced at five feet bearing by a quiescent load of three tons, was - - = .079

And the mean deflection found above, with three tons on a wheel in motion, at rates from twenty-two to thirty-two miles an hour, - - - = .090

Difference, part of which is owing to the depression of the blocks, - - - - - = .011

Upon the whole series of these experiments, Professor Barlow observes that "nothing can be expected much more satisfactory, as it is thus proved, *independently of any opinion*, that while the blocks and fixings are secure, the strain from a passing load is but little in excess of that from a quiescent load."

The above quotations, demonstrating as they do distinctly, that the vertical stress of trains at speed, surpasses so little the effect of quiescent loads of the same weight, (*that it is only necessary to proportion the rails of railroads to resist quiescent, and not concussive forces,*) change the whole face of the question between *cast and wrought iron rails;* they strike away all the objections heretofore urged against the brittleness of cast iron, for it does not admit of doubt, that a beam of that material, of suitable proportions, is quite as competent to carry a quiescent load as is one of malleable iron; again, a cast iron rail will yield sufficiently to impact, and return to its proper level the moment it is relieved of the weight of a train, for it is well known that its elasticity and power of restoration, after deflection, is within certain limits so perfect, that owing to its regularity in that respect it was even proposed by Tredgold to use beams of cast iron as weighing machines, measuring the weights imposed by the deflections produced!

In view of the conclusive arguments of Professor Barlow upon the relative effect of passing and quiescent loads upon railways, we may limit our researches to ascertaining simply the dimensions of a cast iron rail, *which shall have the same surplus strength to resist a quiescent load equal to the maximum weight upon one wheel, as is found in practice to be necessary in a malleable iron rail;* to aid us in this matter we shall again recur to the valuable work from which we have already quoted so much, and upon pages 428 and 430 these statements will be found; that when the road is in good order "the rail is only deflected at the greatest velocity, a little more than is due to a quiescent load, equal to half the weight on two wheels; but that in consequence of imperfections a strain is occasionally thrown on the rail which produces a deflection about double that which belongs to the load in question." And as a consequence of this, results the "experimental fact that with engines of twelve tons weight, (and three tons on a wheel,) running at velocities not exceeding thirty-two or thirty-five miles per hour, *it is not necessary*, even as railways have been hitherto constructed, to provide for a strain of more than seven tons, which is allowing a surplus strength of sixteen per cent. beyond the double of the mean strain," and this was experimentally found to be a strength amply sufficient to resist the lurching of locomotive engines running at high speed. Tredgold, on the strength of metals, informs us that compared with *cast iron as unity*, the strength of *malleable iron* is $1\frac{12}{100}$ times, and its stiffness $1\frac{3}{10}$ times.

Now as the stiffness of rails is a matter of such importance as to be almost the controling desideratum upon railroads, having, in fact, induced the preference given to parallel over fish-bellied rails, it would, perhaps, be proper so to proportion cast iron rails that they may be *as stiff* as those of malleable iron of suitable strength; hence in the case of a railway destined to carry at a high speed locomotive engines of twelve tons weight, and running three tons upon a wheel, as assumed by Professor Barlow, if *a wrought iron rail* possessing an elastic strength of seven tons* is sufficient, *a cast iron one* to have the same stiffness should be proportioned to resist a vertical weight of nine tons, for supposing the stiffness to be as the weights imposed, and the comparative flexibility of the two materials, we have

* The necessity of proportioning rails to resist strains so much greater than is really produced upon a way in accurate adjustment, arises chiefly from an unequal settlement taking place in the two lines of rails, producing that lurching of carriages which sometimes doubles the weight upon a wheel; now, if in all cuttings, and upon all well consolidated embankments, both lines of rails were laid upon *a continuous bed of concrete*, of sufficient depth and width, it would be impossible for the rails to settle irregularly, and if they subsided at all, it would be so equally as to preserve still the proper relation to each other.

1 : 1.3 : : 7 : 9.1, which would give an excess of strength to the cast iron rail in the ratio of $1\frac{3}{10}$ to $1\frac{12}{100}$.

Therefore it will be perfectly safe to assume, as the proper size for *cast iron rails*, sufficient dimensions to give them such a transverse section, as with the fixed length of bearing, will furnish a strength equal to *three times the maximum weight designed to be imposed upon any wheel*, and this is precisely the same conclusion as is arrived at by Mr. Wood, in his valuable treatise on railways, third edition, page 130.

The proportions proper for the section of a cast iron rail may be readily ascertained, either by the formula of Tredgold, which give an excess of strength, and the accuracy of which, up to the limit of perfect elasticity, has lately received ample confirmation;* or the section may be more conveniently determined by the accurate rules given by Professor Barlow, for malleable iron rails, as quoted in the third edition of Wood on Railroads, allowing for the difference between the two materials in the ratio of 1 to $1\frac{3}{10}$.

If, notwithstanding all that has above been said concerning the capacity of cast iron rails to endure successfully the strains which really exist in railway practice, fears should still be entertained of their sudden fracture under trains at speed, all such fears may be completely nullified, by casting in the centre of the head, or top table of the rail, a rod of malleable iron of about a half an inch in diameter, as has already been done with success in cast iron wheels,† to prevent an immediate separation of the fragments in case of sudden breakage; and in addition to subserving its purpose effectually, the wrought iron rod would improve the chill of the head of the cast iron rail to an adamantine hardness.

These observations apply especially to rails supported at intervals only, as is now the usual practice; but if the plan of *continuous bearings*‡ should be generally adopted in railways, the propriety of which has been strongly urged by English engineers, (see an able paper by J. Reynolds, Esq., Civil Engineer, recorded in the second volume Trans. Inst. Civ. Eng.,) as a perfect remedy for acknowledged defects, and which method has been used with success by Mr. Brunel upon the Great Western Railway; *all objections against cast iron rails must wholly vanish;* and with regard to railways of continuous bear-

* See experiments on the strength of cast iron, by Francis Bramah, Civil Engineer, in the second volume Trans. Inst. Civ. Eng.

† At the works of the New Castle, (Del.) Manufacturing Company, and also at other places; by this operation the strength of wheels is very materially augmented.

‡ The tendency of the extensive practice which has now been had on railways is certainly establishing gradually in the minds of engineers a conviction of the superiority of roads of continuous bearing laid with the U, or bridge rail, over those of any other construction.

ing, if the preservative processes now applied to timber should fully answer their intended purpose, without too much expense, as now seems highly probable, it cannot be questioned, that if laid upon Herron's patent trellis plan, or in some other mode, which, with continuous bearing, furnishes also the requisite solidity of foundation, and strength of lateral tie, such roads will possess unquestionable advantages over those laid with isolated supports.

There is another very important fact developed by the judicious experiments of Professor Barlow, which demands the attention of engineers in all subsequent railways, (particularly if they are not of continuous bearing,) whether laid with cast, or malleable iron; and that is, that if rails are supported by isolated bearings at *uniform* distances asunder, *they deflect unequally between the supports when traversed by the trains;* the joint lengths are the most flexible, and consequently, in order that the railway may be equally stiff in every part, the rails must either be made of greater size in the joint bearings, or else the supports at the joint ends must be brought nearer together, in the same proportion as the deflection of the joint length beneath a passing train is greater.

Professor Barlow found by experiments made with his accurate deflectometer, that the heavy rails of the Grand Junction Railway, laid with uniform bearings, deflected under trains running at velocities as high as thirty-two miles an hour, .121 in the joint lengths, when in the middle lengths the deflection was only .090 of an inch.

Consequently, if the rails are of such length as to span *more than two spaces*, and if one of the middle bearings, or spaces, be assumed $= x$, then the joint bearing, if the rail has every where the same transverse section, must be made $= \sqrt[3]{\frac{.090}{.121} x^3}$, or $\sqrt[3]{\frac{3}{4} x^3}$, because the deflection is as the cube of the bearing length; thus if the strength of a rail be calculated for bearings of three feet, and that distance be assumed for the central lengths between the supports, the joint lengths to make the rail equally stiff throughout must be

$$\sqrt[3]{27 \times \frac{.090}{.121}} = 2\tfrac{7}{10} \text{ feet.}^*$$

The principle that the deflections of rails of the same section are *as the cubes of their bearing lengths,* obtains, as a matter of course, in the case of trains at speed; thus in the experiments heretofore cited, the deflection of the Grand Junction rails, with three and three quarter feet bearing, was found by the deflectometer to be 0.353; consequently

* The system of spacing the bearings unequally has been observed by those able Civil Engineers, Messrs. Knight and Latrobe, in planning the new track recently laid upon the Baltimore and Ohio Railroad.

the same rails, at five feet bearing, under trains of the same weight, ought to have deflected $\frac{.0353 \times (5)^3}{(3\frac{1}{2})^3} = .084$, the actual deflection found by experiment was .090 — a sufficiently near coincidence.

IV. On the subject of the comparative durability of wrought and cast iron rails, the experiments are not entirely decisive, but they certainly appear to incline in favour of those of malleable iron;* although it must be remarked that the exfoliation and separation into laminæ, which, owing to the mode of manufacture, it was originally anticipated, would occur to wrought iron rails, when traveled by locomotives at high speed, and the existence of which was formerly most pointedly denied, *does actually take place*, as may be witnessed upon most of our railroads which have been long subjected to the action of heavy trains and high velocities; upon such we may perceive not only exfoliations on the rails, but also that in some instances the sides of the heads have been forced into laminæ, and almost, or actually crushed off; it cannot be doubted that all such disruptions of the material facilitate oxidation and wear, and, therefore, if due weight is given to this cause of deterioration, which was not formerly taken into the account of decay of wrought iron railways, there seems to be reason for the belief, that under the action of a weighty traffic, cast iron rails may reasonably be expected to endure quite as long, if not longer, than those of malleable iron, especially if the former have their heads, or top tables, properly *chill cast*, which ought certainly to be done; it must also be recollected that if from wear, breakage, or any other cause, it becomes necessary to substitute new rails, the old cast iron ones would be worth at the foundries, almost the price of pig metal.

General Remarks.

The introduction of the hot blast, by enabling the ores of iron to be smelted direct with raw bituminous coal, and the recent application of anthracite to the same purpose, rendered successful by the same means, has, in consequence of the diminished cost of cast iron in the coal basins, drawn the attention of enterprizing practical men in this country, to the propriety of employing cast iron rails, instead of those made either of wood plated with wrought iron, or wholly of the latter material.

At the Lonaconing works in Alleghany county, Maryland, cast iron train rails, with an upright ledge, of the usual form, are wholly used for the service of the coal and iron mines.

The writer is indebted to J. H. Alexander, Esq., Civil Engineer,

* See Wood on Railroads, third edition, page 133 and 729.

and Topographical Engineer of the State of Maryland, for the following information respecting the rails cast and used at those works.

1. The Lonaconing rails are of the common tram pattern, of three and a half inches base, and two and three quarter inches height; they are a little heavier at the joints than in the middle; the length of each rail is three and three quarters feet, the weight, forty-five pounds, or thirty-six pounds per yard lineal; for the curves, which are usually of ten feet radius within the mines, separate patterns are used in casting the rails.

2. Some of the rails were cast direct from the ore, and had the furnace continued in blast all would have been.

3. The hot blast was used in casting the greater part of the rails from the cupola, and altogether with those from the blast furnace.

4. There was no difficulty attending either moulding or casting the rails.

5. Intermediate between the ends which rested on a cross tie, there was placed out of doors a block of wood, but within the mines, slate was packed under the rails instead.

6. One hundred and ten tons of rails of the above pattern were laid.

7. These rails are valued at the furnace at $40 per ton by the quantity.

8. The cars run upon these rails carried one ton, or one-quarter of a ton on each wheel, besides the weight of the car.

Mr. Alexander further observes, that from their experience at Lonaconing, he has "no doubt of the useful application of cast iron to larger works, and accordingly the plan of the railroad designed to connect the Lonaconing mines with the Potomac river, rests, in part, upon the adoption of that material."

Since iron has been made in Schuylkill county, in this State, by using anthracite as the fuel for reducing the ore, cast iron rails have been substituted in several coal railways instead of the plate rail upon wood; and wherever they have been used they appear to have fulfilled every expectation formed of their utility, and have been universally approved.

The writer is indebted to Samuel B. Fisher, Esq., of Pottsville, Surveyor, for the following information respecting the cast iron rails employed in that portion of the anthracite region of Pennsylvania.

1. The lengths of rails most used are six feet; but some of twelve and fifteen feet are about to be cast, and any required length short of twenty feet can be made.

2. Some of the rails have been run at the blast furnaces direct from the ore, whilst others were cast by the cupola.

3. The rails are generally laid on cross ties, three feet apart, from centre to centre.

4. Some rails have been cast by Eckert & Guilford, at Pinegrove, with charcoal fuel, of the weight of eighty-four pounds per lineal yard, from a pattern furnished by B. Aycrigg, Esq., Civil Engineer, the section being that of the U, or bridge rail, *cast solid;* the rails now cast at Pottsville are similar to the T pattern.

5. If care is taken in moulding and removing the castings no warping occurs.

6. The rails used under ground for mines, weigh from twenty-seven to thirty-two pounds per yard, whilst others, for outside use, weigh from fifty-three to sixty pounds per yard running.

7. Cast iron rails are found quite smooth enough for use.

8. The cast iron rails cost from $ 40 to $ 45 per ton at the blast furnace, and $ 56 per ton when cast at the cupola from re-melted iron.

9. On the heavier rails, cars, weighing, with their loads, from four to four and a half tons, are drawn by horses at the rate of about four miles an hour.

10. Few, if any, instances have occurred of a rail breaking from regular use.

Mr. Fisher further states, that the rails cast at the foundries are preferred before those run at the blast furnaces.

On this branch of the subject, notwithstanding its importance in an economical point of view, there are no decisive experiments known to the writer, but this much we can declare, that it is by no means a settled point that castings made from re-melted iron are better than those which are run at the blast furnaces direct from the ore; at least, the idea of such superiority seems *to rest wholly upon opinion, and not upon experiment;* in the recent discussion which took place in New York, regarding the conduit pipes and other castings necessary for the supply of water to that city, it was stoutly maintained by the friends of the cupolas that castings from re-melted iron were the toughest and best, and this was as stoutly controverted by the advocates of castings run at the blast furnaces direct from the ore.

In the midst of the dispute, Frederick Graff, Esq., superintendent of the Water Works of Philadelphia, was appealed to, whose long experience in this matter entitles his opinion to the utmost respect, and he stated that the conduit pipes, and all the other castings, now, and for many years, used in the distribution of water through the city of Philadelphia, under a head as high as 100 feet, were made at the blast furnaces direct from the ore; Mr. Graff further declared, that after having, in 1821, repeatedly proved and examined pipes cast in

both ways, he had not been able, "with his experience, from that time to this, to determine why a pipe cast from the ore was not as good as one cast from re-melted iron, nor had he been able to determine why other castings cannot be made as perfect and durable from the ore as in any other manner."

On the other hand, the experiments detailed in Wood on Railways, third edition, page 127, show clearly enough, that a mixture of different kinds of cast iron forms a stronger, though also a heavier rail, than any one kind of iron cast separately; and this mixture can evidently be had only by re-melting iron through the agency of a cupola furnace.

But let this be as it may, there is no doubt that rails of sufficient strength can be most economically cast direct from the ore, and they would be cheaper than those produced at the foundries, even if it should be found necessary slightly to enlarge their dimensions.

The writer has been informed by Erskine Hazard, Esq., one of the managers, and Josiah White, Esq., the president, that the Lehigh Coal and Navigation Company having adopted a heavy T- rail of malleable iron, for their railroad from Whitehaven, upon the Lehigh, to Wilkesbarre, upon the Susquehanna, a distance of twenty miles; contracted for it in England, at £10 10*s.* per ton; but one ship-load having been lost at sea, they resolved to supply its place with rails cast from anthracite iron, at the furnace now in operation upon Crane's principle, on the Lehigh Canal, about fifty-five miles below Whitehaven, the eastern terminus of the railroad; and with these they purpose laying about four miles of the road next to Wilkesbarre, on which horses are to be used.

The malleable iron T rail of the road referred to, weighs forty-eight pounds per lineal yard, and is near five inches deep, three quarters of an inch thick in the stem, and two inches wide on the head; the cast iron rail designed to supply its place upon four miles of the road, is of a similar section, but made six inches deep, a little larger every way, and weighs seventy-five pounds to the yard; it is cast in six feet lengths, direct from the ore, by anthracite worked with the hot blast.

The strength of this rail was tested at the furnace, with six feet bearing, and it required *more than* five tons weight to fracture it; consequently, at three feet bearing, its strength (with the same section being inversely as the distance between the supports,) is ten tons, but we have already shown, in a former part of this paper, that, according to Professor Barlow's experiments, and the relative properties of cast and malleable iron, an available strength of nine tons in a cast iron rail is ample to sustain the progress of trains carrying three tons on a wheel, and running at thirty miles an hour; consequently, if the

rail of the Lehigh and Susquehanna road is laid with three feet bearings, as is now contemplated, it will be equal to all the present exigencies of trade, and might be safely traveled by twelve ton locomotives at a very high speed; this rail covering *but two bearing spaces* between the joints, ought to have its supports spaced equally, which is, in fact, designed.

The writer has recently observed upon the Columbia railroad, a short distance laid with cast iron rails, apparently for trial; these are in section nearly parallelograms, about two inches thick by five inches deep; they are wedged in cross ties, about three feet apart, and appear to answer perfectly.

In a former part of this paper, we showed that a cast iron rail, of strength sufficient to resist, without permanent injury, a strain of nine tons, was equivalent in stiffness to a wrought iron rail of seven tons strength, and this ratio we took as the guide of comparison between rails of these materials; hence assuming that the weights of rails suitable for the same railway should be as these numbers, then if a wrought iron rail of seventy pounds per lineal yard is competent to carry any given trade, a cast iron one, proportioned for the same traffic, should weigh ninety pounds per yard, for 7 : 9 : : 70 : 90.

The cost of the *imported wrought iron rails* of the Lehigh and Susquehanna railroad, when delivered on the road, will be about $ 65 per ton, whilst those of *cast iron*, for the same road, will scarcely exceed $ 45; therefore, if the latter was strictly proportioned in strength to the former, the ratio of economy at the above rates would be,

70 tons at $ 65, - - - - -	= $ 4,550
90 tons at $ 45, - - - -	= $ 4,050
Difference, -	= $ 500

which, with these particular prices, would make the cast iron rails cheaper than those of English rolled iron, in the ratio of nine to eight; and if compared with American wrought iron rails, the relative economy would be still more conspicuous; the price of foreign railway iron delivered in America, fluctuates very much, but it is believed that it would very seldom be so low as to make the rolled rails cheaper than those of cast iron of equal strength, even if the former should continue to be admitted into our ports free of duty. We do not wish to be understood as asserting, in this paper, that cast iron rails are intrinsically superior to those of malleable iron; all that has been proposed is to show that the former material is equally sufficient and suitable for the formation of railways, whilst it is generally *more economical;* but there is one practical advantage which is inherent to cast iron, and ought not to be overlooked, it is, *that it expands and contracts*

less than wrought iron by alterations of temperature. Tredgold's essay on cast iron, informs us that whilst malleable iron expands $\frac{1}{143000}$ of its length by each degree of heat, cast iron elongates but $\frac{1}{185000}$ by an elevation of temperature to the same extent, consequently their ratio of comparative dilatation is nearly as seven to eight.

That cast iron is thus refractory under heat, is of some practical importance, for if the rails be cast in lengths of ten feet, the lineal elongation produced by an alteration of 100° in the temperature, would be only $\frac{1}{1850}$, or about $\frac{1}{14}$ of an inch, so that if rails of from six to ten feet lengths are used, and the laying is carried on at medium temperatures of the weather, they may then be placed almost, or quite in contact end to end, the unavoidable imperfections of the joints allowing sufficient play; and as the joints will therefore be so much closer than can be admitted with malleable iron rails, less objection will be made, even if their number should be greater.

James Herron, Esq., Civil Engineer, in a memoir descriptive of his patent Trellis railway, of continuous bearing,* which he has recently laid before the public, makes, at page 35, the following judicious remarks, touching the subject we have under discussion, and which we take the liberty of quoting:

"That cast iron rails can be furnished from our own mines at a much cheaper rate in the United States, than foreign rolled iron rails, seems probable from the improved modes of smelting iron with anthracite coal. That they will fully answer the purpose, when constructed and laid as I have described, there are but few engineers of practical experience in mechanics, and who are familiar with the extensive use made of cast iron edge rails throughout England and Wales, on their mineral railways, will deny. Should there be some, however, who are disposed to advance adverse views, it matters not from what motives, let me ask them why is it that the chilled cast iron wheels of our railroad cars should have so completely superseded the imported wrought-tired wheels, if it be not their *greater durability and cheapness* that recommended them?

"Within the last two years, some millions of dollars have been sent out of the country for the purchase of railway iron, which has been, for the most part, admitted duty free, and if we may form an opinion from the rapid deterioration by crushing, exfoliation, and splitting of the heavy rolled iron rails but recently laid *on some of our roads*,

* A very ingenious railway of continuous bearing, has been devised by B. H. Latrobe, Esq., Civil Engineer, (see the March No. of this Journal, 1841,) consisting of a Z rail attached laterally to a continuous string piece; this peculiar arrangement is strikingly deserving of trial upon a working scale, and *on a bed of concrete.*

many millions more must continue to follow them, to furnish a supply for the renewals and repairs, so that it will form an insatiable drain on the currency of the country.

"A material that enters so largely into, and forms so costly a part of, our great public works, should not, therefore, be imported from a foreign country, if we can by any possible device render our native materials available. That the large sums of money which would thus be retained in the country would greatly benefit the mining, manufacturing, and farming interests, and, in fact, all others, even the works themselves, by an increase of business, must be evident to all."

Reflecting, then, upon the following facts, that for a long series of years cast iron rails were successfully used in England for public railways, that they are now used a great deal in the mineral districts, that they were originally superseded, in consequence, chiefly, of the superior economy of malleable iron rails, that so far as they have been used in this country they have fully answered every expectation, that the peculiar character of the strains upon a railway is such as cast iron is well calculated to withstand, that they can be well and cheaply made in this country, instead of sending our money abroad for foreign iron, that the transportation of iron rails from the sea-board to many of the interior railways, is very expensive, and finally, that they are as cheap, or cheaper, than wrought iron rails of equal strength*—can there be any reason why cast iron rails should not be universally adopted in the United States? On the contrary, are we not urged to their exclusive use by every consideration of economy, as well as of patriotism in supporting home, instead of foreign manufactures? And do not the arguments in favour of *cast iron rails*, appeal with peculiar force to all those states, which, like Pennsylvania, possess within their bosoms inexhaustible supplies, both of the ores of iron and the means of fusing them into metal?

Philadelphia, September 1st, 1841.

Remarks on the Bear Valley Coal District, in Dauphin county, Pennsylvania. By WALTER R. JOHNSON, *A. M., Civil and Mining Engineer, Professor of Chemistry and Natural Philosophy, in the Medical Department of Pennsylvania College, Philadelphia. Late Professor of Mechanics and Natural Philosophy, in the Franklin Institute.*

This coal district embraces a very large amount of valuable coal land, and is one of the most accessible and most easily wrought, of all our Pennsylvania coal deposites.

* The Congress of the United States, at their late session, have passed a law providing that from and after the 3rd of March, 1843, all foreign railroad iron imported into this country,

It lies between Lykens' Valley on the north, and Williams' Valley on the south; these two valleys being bounded, the former, on the north by Mohantango Mountain, and the latter, on the south, by Berry's Mountain.

These are termed red shale valleys, and are rich, productive, and extensively cultivated, yielding abundant supplies of agricultural produce suitable for a large mining district.

The coal formation proper is included in an elongated basin, or trough, called Bear Valley, situated between two elevated ridges, viz: Thick Ridge, on the north, dividing it from Lykens' Valley, and Big Lick Ridge, on the south, which separates it from Williams' Valley.

The approach to this valley is through a deep cut, or gap, in the Big Lick Ridge, called Bear Gap, formed by a creek which comes out of the valley and joins the Wiconisco, by which its waters are conveyed to the Susquehanna river at Millersburg.

This gap extending quite through the southern brim of the trough, and dividing the various beds of which the coal measures are composed, has left the edges, or rather *ends* of the coal seams so exposed, as to be entered by horizontal drifts, or gangways, involving no necessity for artificial draining. The coal seams both east and west of the gap, dip northwardly in an angle of about forty-five degrees, and hence when the gangways have been driven to the proper extent, the workings commence in an ascending direction, and the coal is delivered to cars in the gangways over shutes formed on the floors of the beds themselves. On some of the beds the breadth of working, or breast of coal, will not be less than 600 or 800 feet. In others it will probably exceed 1000 feet. This facility of delivering the coal obviates the necessity of handling it after being detached from the solid bed. The mines which I examined were perfectly dry, and more comfortable, therefore, than almost any others which I have visited in the anthracite coal fields.

But besides the facility of mining the coal on the southern side of the trough by means of the exposure of the ends of beds at the gap, there is the additional advantage of approaching the northern or south-dipping beds by means of a tunnel to be carried horizontally across the beds northwards, and through all the interposed strata of slates, sandstones, iron ores, fire clays, &c., and as each successive bed is reached, working right and left by drifts in a manner perfectly analogous to that which is now pursued at the gap.

The openings on these south-dipping beds, on the property of the Lykens' Valley Coal Company, at different heights on the slope of the ridge, have disclosed the fact that in numerous beds good coal is found even at a very few feet from the surface, with roofs and floors

shall be subject to "a duty of twenty per cent. ad valorem," and that no iron shall, hereafter, be allowed to enter duty free, except what may be required for railroads, or inclined planes, *now under construction*. This act would seem to settle the question of economy decidedly in favour of the use of cast iron rails, on all future railroads constructed by the American people.

of adequate consistence to allow of mining to within a few yards of the outcrop.

If all the beds of the formation, known to be eighty feet in aggregate thickness, lay in a horizontal position, a single acre of land in which they were so situated would contain 129,066 cubic yards, or the same number of tons of coal; and if the same thickness of coal in a single bed, or succession of beds, were inclined at an angle of forty-five degrees, the quantity of coal in an acre would be increased in the proportion of 142 to 100, or it would then be 183,273 tons. All the beds of an inclined formation may be worked on a single acre of land, supposed to extend in a very narrow strip quite across the breadth of the trough, and the whole number of acres may therefore be considered as possessing like advantages over the same number of acres, of which the strata should be supposed horizontal. Now 370 acres of the above company's lands lie in a broad belt stretching directly across the coal measures, and embrace as well those parts of the beds which lie below water level, as those which in the two mountain ridges rise up several hundred feet above that level. In these 370 acres there would be found, by the preceding computation, 183273 × 370 = 56,268,010 tons of coal. Admitting that from denudation and other causes, only one-tenth as much coal shall ever be obtained, the yield of this small portion of the lands will be 5,626,801 tons, or such an amount that if 50,000 tons per annum were taken out, a century would be far from exhausting this limited part of the company's domain.

The present workings have hardly passed the threshold of the formation—and are in the thinner and less valuable beds, as all observation and experience tend to demonstrate. Even on the "Gap tract," so called, many of the more important beds of the formation remain yet to be explored.

The following sketch exhibits the inclination, thickness, and distance apart of the beds in Thick Ridge, as observed and carefully measured at Raush Gap, and confirmed by numerous openings opposite to Bear Gap. For this sketch I am indebted to Mr. P. W. Schaeffer, who prepared it from actual measurements. The dip is south eight or ten degrees east, about forty degrees.

From this sketch it appears that the total thickness of coal in the formation is not less than eighty feet on the north side of the trough, (and the same will doubtless apply to the south ridge,) and that more than two thirds of this thickness is found in seven beds lying in the inner, or *upper*, portion of the formation, and within a space of 130 yards measured horizontally across the strata. The openings at Bear Gap demonstrate the same general feature. Hence it is confidently believed that in a distance of two hundred yards, at most, all these beds will be reached by the tunnel above proposed, if commenced in the most favourable situation.

The tunnel might be twelve feet wide and seven high, and its execution might be progressive as new beds were required to be opened. The cost of excavation could not, I judge, in the materials here found, exceed ten dollars per lineal foot, for the first 200 yards.

Section in Thick Mountain, East side of Rausch Gap.

P. W. SHAEFFER.

In the beds to be reached by this tunnel, coal could be mined for fifty cents per ton, agreeably to the estimate of Mr. Schaeffer, who has been long conversant with the operations in this coal field.

Character of Lykens' Valley Coal.

This coal is of the variety generally known in commerce as free burning red ash coal. It enjoys already a high reputation for giving, when used for domestic purposes, a steady but lively heat, and yielding little earthy residuum. It is also highly esteemed by smiths and founders; and not less so by those who have applied it to the production of steam, the burning of lime, and the smelting of iron.

The exterior characters of the coal of different beds are somewhat various; and it is not a little remarkable that the kind most sought after by blacksmiths, is that which, at first sight, might seem the most unpromising, being often covered almost entirely with a coat of yellowish or red oxide of iron, from which it has received the name of the "rusty vein." In other beds the coal is of the clearest jet black, and presents the varieties of tint, dull and bright, due to a greater or less intermixture of mineral charcoal with the pure anthracite.

The following analyses of this coal, with the subsequent comparison between it and the Welsh anthracite used by Mr. Crane, may be interesting in view of its applicability to iron manufactures.

The anthracite of Bear Valley is marked with numerous impressions of the vegetable substances from which the coal has been derived. These are not confined to the slates, but penetrate the body of the anthracite itself. The fossils are precisely similar in kind to those found in this and other countries, among the beds of bituminous coal, and correspond perfectly with descriptions already extant; and the minutest characteristic line traced on a bituminous coal slate in Great Britain, France, Germany, or South America, has its exact counterpart in the anthracite fields of Pennsylvania. Indeed there can no longer exist a question about the fossils of anthracite and bituminous coals belonging to the same geological period, since we know, that in one and the same coal trough we have perfect anthracite at one end, and perfect bituminous coal at the other, with a regular gradation of qualities between them.*

Among the many varieties of anthracite found in Pennsylvania, none, according to my observation, bears a stronger analogy to that of Yniscedwyn in Wales, used at Crane's iron works, than the coal of Lykens' Valley.

The first step in tracing this analogy is to mark the relation by external characters.

These, in the Welsh coal, are,

1. A structure often lamellated, and tending to separate at the surfaces of deposition, owing to the quantity of carbonaceous clod which constitutes the dull seams between the bright plies of coal.

* The fossils most frequently observed at Bear Valley are various species of Filicites Stigmariæ, Lepidodendra, Calamites, &c. A specimen of Stigmaria ficoides four inches broad, was found imbedded in pure anthracite.

Tabular view of the Analyses of nine samples of Anthracite from the mines of the Lykens' Valley Coal Company.

No. of the sample.	Specific gravity.	Water expelled at 320°.	Volatile matter lost at redness.	Fixed carbon.	Earthy residue.	Exterior and other characters of coal.	Character of ashes.
1	1.391	1.460	6.140	87.950	4.450	Deep black—fracture irregular, shining—or dull from intermixture of charcoal—of which the structure is distinctly seen—and which is soft, sectile, and easily combustible—gives out gas, but does not change form on being ignited.	Colour deep brown—inclining to reddish brown—light—little coherent, moderately gritty.
2	1.404	1.390	4.56	89.300	4.750	Brownish black—iridescent or steel blue—surface shining and striated—woody structure of the mineral charcoal seen as above—gas burns brightly.	Light fawn colour, moderately gritty—light—slightly coherent.
3	1.416	0.70	9.30	85.700	4.300	Lustre silky on a carbonaceous ground — mixture of mineral charcoal in certain parts, with a coke-like mass.	Brownish buff—slightly coherent.
4	1.374	1.10	3.50	88.700	6.700	Very similar to the preceding.	Brownish — dirty red, with slight tinge of purple — very slightly coherent — incineration probably not quite complete.
5	1.376	0.88	7.47	87.750	3.900	Colour deep black—fracture uneven with appearances of coke or charcoal.	Yellowish red—inclining to brown—dense—coherent.
6	1.395	0.90	7.40	88.650	3.050	This sample is less marked with carbonaceous deposites than the preceding—a purplish red tint marks some of the partings, or cross cleats.	Colour deep fawn, gritty—heavy, coherent.
7	1.382	0.090	7.75	87.200	4.150	Colour deep black—surface shining, striated, silky, and occasionally of a dull charcoal lustre—fracture uneven, original grain apparently obliterated by pressure.	Bright fawn—with slight tinge of rose colour, gritty, coherent.
8	1.398	1.314	10.54	83.996	4.150	Appears to resemble certain varieties of bituminous coal in structure, fracture and lustre, with slight specks of pyrites.	Bright buff colour, tolerably coherent—slightly gritty.
9	1.378	1.360	5.94	87.000	5.700	Dull black—surface shining at the fractures which cross the grain of the coal—horizontal seams conspicuous, fine carbonaceous dust seen in the interstices.	Incineration not quite perfect, minute particles of coal perceptible—colour deep fawn.
m'an	1.390	1.111	6.955	87.360	4.572		

2. The abundance and magnitude of reeds and stems constituting the charcoal deposites, traversing the anthracite.

3. The shining and polished surfaces occasionally presenting themselves to view at some of the natural partings.

4. The purplish tints of metallic oxide often observable on the surfaces of fracture.

5. The general colour is deep black, and either dull, or shining, according as the ply which is examined belongs to the anthracite itself or to the carbonaceous clod partings of the seams.

By observing attentively the external characters described in the seventh column of the preceding table, it will be seen that all the foregoing distinctive marks belong also to the anthracite of the Bear Valley coal field.

The next circumstance worthy of attention in tracing the relation of coals, is their specific gravities. In the Welsh anthracite this is from 1.336 to 1.372, not much greater than that of many bituminous coals. The nine samples of the table above given afford a mean specific gravity of 1.390; the highest being 1.416, and the lowest 1.374.

The quantity of *volatile matter* next deserves notice. Of this, the Welsh anthracite contains by the mean of *two* trials made by myself, - - - - - - 9.18 per cent.

of *two* by Mr. Mushet, 7.23 "

of *one* by Mr. Frazer, - 7.60 "

The mean of these *five* is - - - 8.072

The water and *other volatile matter* in my analyses of Lykens' Valley coal are separately determined; the mean of water is 1.111, and of other gases, 6.955; the sum of which is 8.066.

The mean quantity of earthy matter in the Welsh anthracite by three of Mr. Mushet's trials is - - 3.578

by one of Mr. Frazer's - - 5.080

and the average of these two is - 4.329

In the Lykens' Valley anthracite, the table shows a mean of 4.572.

The quantity of carbon in the coal of Yniscedwyn as deduced from the preceding data is 87.599, while the table shows 87.360 in that of Lykens' Valley.

Bringing the preceding statements into a single view, the analogy will be perceived at a glance.

	Sp. Gr.	Vol. Mat.	Carbon.	Ashes.
Yniscedwyn coal,	1.354	8.072	87.599	4.329
Lykens' Valley do.	1.390	8.066	87.360	4.572

If any thing more were wanting to make out the absolute identity of character in these coals, so remote from each other in locality, it would be supplied by the perfect similarity of effects observed to result from their distillation, yielding at first a gas burning with a pale blue flame, and afterwards, as the temperature rises, one of strong illuminating power, accompanied by a minute portion of bituminous, condensible matter. The illuminating gas seems to commence sud-

denly its development from the Welsh coal, and perhaps also from that of Lykens' Valley, but in the latter this circumstance was not particularly noted.

Rich and valuable as are the beds of anthracite in Bear Valley, it will be seen from what follows that these are not the only minerals worthy of consideration, embraced within the district. Like all other known coal formations, it is interspersed with seams of argillaceous carbonate of iron, but as no researches have yet been expressly directed to this object, but little more than the outcrop has hitherto been explored.

Iron Ores.

The following analyses of the iron ores found in contiguity with the coal beds of Bear Gap, were made in the dry way, and may, consequently, be regarded as very nearly representing the results which would be obtained in the process of actual manufacture, except that as the ores were from near the outcrop of the bed they are rather richer in iron than they would have been, if not exposed to the influences of air and moisture.

No. 1. *Species.*—Argillaceous carbonate, passing into hydrated peroxide of iron.

Description.—Form spheroidal; texture, coarse; colour, from grayish blue to reddish brown.

Specific gravity, at 62° Fahr. 3.40.

Water expelled at 350°	2.82 per cent.
Loss by calcination,	20.87 "
Pig metal obtained,	42.37 "
Earthy matter,	21.84 "
Oxygen,	12.10 "
	100.00

The pig metal obtained in this assay was moderately hard, amorphous, or granular in structure; of a mottled grey colour. The cinder was ash-coloured and opake.

No. 2. *Species.*—Hydrated peroxide of iron—argillaceous.

Description.—Colour, reddish brown; fracture irregular—sectile—soils strongly.

Specific gravity, at 64° 3.347.

Water expelled at 320°	0.89 per cent.
Loss by calcination, chiefly water,	10.51 "
Yield in pig metal,	51.35 "
Oxygen,	22.00 "
Earthy matter,	15.25 "
	100.00

Pig metal moderately hard; structure, fine granular; colour, lively grey.

Cinder—a purplish, semi-transparent glass.

No. 3. *Species.*—Nearly the same as the preceding, and probably derived from the same bed.

Specific gravity, at 69°	3.286.	
Water lost at 320°	1.00	per cent.
Loss by calcination,	10.13	"
Pig iron,	51.60	"
Oxygen and earthy impurities,	37.27	"
	100.00	

Pig metal lively grey, moderately hard, and rather brittle, compact; fracture smooth.

Cinder—a purplish, smoky glass.

No. 4. *Species.*—Argillaceous carbonate of iron, nearly hydrated or transformed into hydrated peroxide of iron.

Description.—Colour, bluish grey; structure, coarse, hard; fracture, uneven, splintery.

Specific gravity, at 61°	3.463.	
Water lost at 320°	14.95	
Loss by calcination,	9.92	
Pig iron,	51.80	
Earthy matter and oxygen,	25.33	
	100.00	

The pig metal is compact, but soft; dark mottled; lighter portions ranged in minute pentagonal figures. Cinder, a black glass.

No. 5.—Characters similar to the preceding.

A portion of the exterior shell is sectile; interior, hard.

Specific gravity, at 61°	3.480.	
Water lost at 320°	1.69	
Loss by calcination,	10.83	
Pig metal obtained,	54.15	
Earthy matter,	13.66	
Oxygen,	19.63	
	100.00	

Pig metal soft, moderately tough; dark mottled; fracture rough, without signs of crystalization. Cinder, a dark coloured opake glass.

Tabular view of the Analyses of Iron Ores of Bear Valley.

Specimen	1	2	3	4	5
Variety of ore.	Argil carb. and hyd. perox.	Hyd. oxid.	Hyd. oxid.	Argil. carb. and hyd. oxid.	Argil. carb.
Specific gravity,	3.40	3.347	3.286	3.48	3.463
	per cent.	per cent.	per cent.	per cent.	per cent.
Loss by calcining,	23.09	11.40	11.13	12.52	14.88
Pig iron,	42.37	51.35	51.60	53.05	51.80
Earthy matter, &c.	34.54	37.55	37.27	34.43	33.32

The specimens above analyzed are all from near the outcrop of a bed, as indicated by the hydrated shell, or crust, on the exterior, and

are therefore richer in iron than the average of the same bed will be, when pursued under a sufficient covering, to yield the blue argillaceous carbonate in its unaltered state. It will then probably range somewhere between thirty-three and forty-two per cent. of metallic iron; give a loss of more than thirty per cent. by calcination, and contain, perhaps, twenty-five per cent. of earthy matter.

The distance from the point where I have proposed that a tunnel shall be commenced, to the Susquehanna river, is sixteen miles, traversed by the Lykens' Valley Rail Road. The superstructure of this road requires to be renewed with T rails, fit to bear transportation by locomotives, and the grading on one section to be altered so as to render the whole line either level or descending in the direction of the freight. This alteration will likewise improve the *plan* of the road, removing, or diminishing, several curves, and with these changes, it will, I conceive, be made one of the best railroads for descending tonnage in the coal regions of Pennsylvania. It terminates on the river at the mouth of Wiconisco creek, and at the commencement of the Wiconisco canal. This canal, 12¼ miles long, connects with the Susquehanna canal at Clarke's ferry, is now nearly completed, requiring only one or two aqueducts and two or three locks to be made, with unimportant excavations to be finished, to place it in a condition to receive the water. Of an original estimate of $ 416,000 for making this canal, $ 364,500 have already been expended, leaving only a balance of $ 51,500 required to complete the work. For this comparatively trifling sum, it is not to be supposed that the state will forego the advantage of receiving the great amount of tolls which this mineral region can bring, not only to the Wiconisco, but also to the whole line of state canal from Millersburg to Columbia, a distance of fifty-three miles.

The coal will reach tide water at Havre de Grace, 98¼ miles from Millersburg, where it will have cost, agreeably to an estimate by Mr. Schaeffer, (which seems to me ample for every item of the expense, at least in the aggregate,) the sum of $ 3.12½ per ton. The boats used on this line of navigation will carry sixty-five tons, and being covered over with suitable hatches, may be towed to Baltimore, in which case, the coal delivered on the wharves need not cost over $ 3.50 per ton.

In conclusion, I would remark, that I know of no other anthracite coal district among the many hitherto brought into active operation, which combines all the advantages possessed by that of Lykens' Valley. Its abundant supplies of coal and iron ore, its facilities for mining, the excellence and high repute of its coal, its fortunate connexion with a well located rail road, and at the end of that, with a capacious canal terminating at tide water, and having the Susquehanna river for its supply, with all the markets both of the south and east accessible during every month in the year, from the city of Baltimore, where the main depots of this coal will naturally be made, are circumstances which cannot be overlooked by any one who understands the value of a coal formation, or the innumerable purposes to which its treasures are applied.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN SEPTEMBER, 1840.

With Remarks and Exemplifications by the Editor.

1. For a method of *Channeling and Scarfing the Soles of Pumps, Shoes, &c.;* Lewis Baker, Fort Plain, Montgomery county, New York, September 2.

The apparatus used consists of an iron *form* of the shape of that part of the sole to be channeled and scarfed, which is to be tacked on to the said sole, and of two cutting instruments, one attached to each end of a handle. One of these has three knives projecting from the end of a block of iron, or steel—the outermost of which is sufficiently long to cut through the sole, and the other two of half that length, and as far apart as the width of the tongue to be formed. The other instrument is formed with a gauge, in place of the long outside cutter of the first instrument, and of two cutters that incline towards each other, their points being as far apart as the width of the tongue, so that they may cut out two parallel triangular strips of leather from each side of the tongue. An instrument used for making a channel on the inner side of the tongue, and scarfing the outer edge of the sole is also described, and is similar to the one last named, excepting that the cutter next the guard instead of inclining towards the other cutter, inclines in the same direction with it, and towards the guard.

The form serves as a guide in using the instrument. Claim.—"What I claim as my invention, and desire to secure by letters patent, consists in the combination of the cutting instruments with the form as before described."

2. For an apparatus for *Boiling and Washing Rags*, used in the manufacture of paper; George Spafford, Windham, Windham county, Connecticut, September 2.

The patentee says—"In my improved boiler and washer, the rags are to be subjected alternately to the influence of high pressure steam and an alkaline liquid; said boiler being so constructed as to be capable of being made to revolve upon its axes, which are formed hollow, for the purpose of introducing steam from a separate, or ordinary engine boiler; and also of introducing water, or an alkaline solution, when desired, for the purpose of washing the rags which have been boiled.

"Having thus fully described the nature of the apparatus used by me, &c., what I claim is the construction and use of a cylindrical, revolving boiler, and washer, the interior of which is divided into four, or any other convenient number of compartments, by grated partitions, within which the rags are to be subjected to the action of high steam, and of an alkaline solution, in the manner, and for the purpose above set forth."

Each of the compartments, into which the cylinder is divided, is provided with a hole, and cover, similar to that of the main hole of a steam boiler, for the purpose of putting in and removing the rags, &c.

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3. For an improvement in the machine for *Cutting Staves;* Isaac Hosmer, and William P. L. Badger, Concord, Middlesex county, Massachusetts, September 2.

This machine is designed as an improvement on that kind of stave-cutting machines which cut them from a block, or bolt, by means of a curved knife attached to radial arms, and the improvement consists in shifting the position of the axis of vibration, by having the axle to slide in slots in the arms, so as to make staves for barrels of greater or less diameter. The standards in which the axle has its bearings are also made to slide, that they may correspond to the change in the length of the arms without changing the position of the knife.

Claim.—"We claim the method of shifting the axis of vibration without changing the position of the knife, by means of the movable standards, in combination with the shaft, or arbor, and the slots in the radial arms, as described."

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4. For an improvement in the machine for *Making Stove Pipes, Mouldings, &c.;* John Farrar, Cuyahoga Falls, Summit county, Ohio, September 2.

This patent is taken for a modification of the machine well known to sheet iron workers, in which the stove pipe is formed by rolling the sheet on a cylinder which works against a roller, the cylinder being provided with a groove along it, which receives one edge of the sheet of iron. The so called improvement consists simply in substituting for the roller, against which the cylinder works, a concave bed, which surrounds one half the circumference of the cylinder, and the claim is limited to the "employment of a cylinder with a groove, in combination with a concave bed."

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5. For a machine for *Making Rivets;* Alpheus Fobes, Assignee of Charles Lyon, and Fitch W. Taylor, Assignee of Alpheus Fobes, Assignee of Smith Gardner, and Assignee of Charles Lyon, of New York City, September 2.

The claim is confined to the method of feeding the rod, and to the arrangement of the parts constituting the die plates; and as the claim refers throughout to the drawings, and could not be understood without them, we will merely furnish a general idea of the principal characteristics of the machine.

The tongs which hold, and carry the rod forward, are put in motion at each operation of the machine by a connecting rod, which receives motion from a pin, on the crank which actuates the leader. When the tongs are drawn forward to feed, a projection from the connecting rod first comes into contact with the levers, or handles, of the tongs, and causes them to gripe the rod, the whole then moves

together to the distance required to make the rivet; and on the return of the connecting rod, which is effected by a spiral spring wound around it, the levers of the tongs are first liberated, and then drawn back to be ready for a second operation. The die plate is provided with two dies, one permanent, and the other movable, and the rod passes through a hole in a plate, on the face of which the die plate slides. In the operation of the machine, the sliding die is first put in motion, which gripes that end of the rod which is to be made into a rivet, the whole die plate then slides past the hole in the plate, on the face of which it works, thus cutting off the blank and preparing it to receive the blow of the heading die.

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6. For a machine for *Making Hook, or Brad-headed Spikes;* Henry Burden, Troy, New York, September 2.

The patentee says—"In my improved machine, the feeding in of the rod, the cutting it off, and the pointing of the spike, are effected in the way previously used by me for performing the same offices in my ordinary spike machines, or adopted by others; and my improvement for forming the spikes with hook, or brad, heads, may be applied to spike machines of various constructions.

"My improvement consists principally in the employment of what I denominate a bending lever, or some analogous device, by means of which a portion of the rod which is to constitute the head is bent down so as to form an angle with the shank, and in then forcing up a heading die, properly formed, so as to upset the bent portion, and to cause it to assume the desired shape."

The claim is limited to the bending that portion of the rod which is to be formed into a hook head, by means of the bending lever, and also in forming the heading die and the parts of the griping dies, within which the bent part is to be upset, so as to give the proper form to the hook, or brad-head.

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7. For an improvemént in the machine for *Cutting Veneers;* John Dresser, Stockbridge, Berkshire county, Massachusetts, September 2.

This machine, like some others, is to cut the veneer from a block, by means of a knife, the edge of which is forced against the block; the novelty consists mainly in so modifying it as to make it applicable to the cutting of veneers from a round log. Such a log is to be fixed to the mandrel of a lathe, and held by a centre screw; the knife is attached to a frame, or carriage, which slides on the bench at right angles to the axis of the log. As the log is put in motion the knife is forced up to it, and cuts therefrom a veneer, the thickness of which can be regulated by the change in the relative motions of the log and knife. The claim is limited to the manner of "cutting veneers with a knife from cylindrical blocks of timber, revolving in a common turning lathe, or other similar machine."

8. For an improvement in ***Railroad Switches;*** Nathaniel Eaton, Worcester, Massachusetts, September 3.
(See specification.)

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9. For an improvement in the ***Paper Engine;*** William Dickinson, Worcester, Massachusetts, September 3.

Heretofore, the cylinder of the paper engine has been hung with one gudgeon in a permanent box, and the other in a box attached to a lever, called by paper makers a "lightener," and serving to elevate, or depress, the cylinder; but as this acted on one end only of the cylinder, an exact parallelism could not be preserved between the surface of the cylinder and the knife below it. To remedy this defect is the object of the improvement under consideration, and this consists in adding another lightener to the other side of the cylinder, and connecting the two together, so that in elevating, or depressing, the cylinder its surface shall always be parallel with the cutters below. To this improvement, or device, the claim is confined, and it would be difficult to confine a claim within narrower limits.

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10. For *Flower Pots, or Vases;* Joseph Adams, Boston, Massachusetts, September 3.

The vases, or flower pots, described, are to be made of wood, earthen, or stone ware, or of any other suitable material, if made of any material which will allow water to percolate through its pores; the vase is to be lined with metal. A metal vessel is made to fit within the vase, the lower part of which is of such diameter as to leave a chamber for water between it and the inside of the vase. The lower part of the inner vessel is perforated with a few holes, through which the water is supplied to the plant. The claim is confined to the inner vessel, constructed as described, in combination with a flower pot, or vase. If we have not seen, we have certainly dreamt of ornamental vases, or flower pots, so nearly like the foregoing that they might be mistaken for twins.

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11. For *Constructing, and Supplying Water to, Steam Boilers;* Cadwallader Evans, Pittsburgh, Pennsylvania, September 3.

The improvements described in this specification are applicable to that kind of steam boilers generally used on the large boats of the western waters, in which a number of cylindrical boilers are arranged side by side. The first improvement is in placing the pipes of communication between the respective boilers in the same tier above the tops of the flues within, so that when the boat careens, the water cannot flow from one to the other, below the tops of the contained flues, thus avoiding one of the causes of those accidents which are believed to arise from the over-heating of the flues when not covered by water. The second improvement consists in combining with the foregoing the manner of arranging the supply tubes so as to force the water into the outside boilers only, and at the same elevation with the tubes

of communication; thus insuring a sufficient and equal supply to all the boilers; the end boilers being always supplied up to the level of the communication pipes, no matter how much the vessel may careen.

The third improvement consists in placing a balance valve in the supply pipe, so constructed as that when the boat careens the weight of the valve will cause it to close the pipe that leads to the lowest valve, and thus force the whole supply of water to pass through the most elevated boiler.

The claim is confined to these three improvements.

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12. For a machine for *Separating Garlic from Grain;* William C. Grimes, York, York county, Pennsylvania, September 3.

The patentee says—"I proceed upon the fact, or principle, that the wheat, or grain, will completely resist any force which would be necessary to drive the garlic through a groove, or crevice." "But whatever may be the form or modification of the machine, I prefer, and use no other than projectile force."

A hollow, radial, chambered wheel revolves within a case surrounded by rings, which form conical openings, or grooves, all around, which either revolve in connection with the wheel, or remain fixed. The grain is fed into the hollow shaft of the wheel through an appropriate hopper, and is discharged by centrifugal force through the conical grooves formed by the rings.

Claim.—"What I claim as new, as my invention, and desire to secure by letters patent, is the mode of separating garlic, and other foreign matter, from wheat and other small grain, by means of the combined action of a hollow radial chambered wheel, and a series of rings, revolving in connection with, or remaining fixed around it, as herein set forth; the rings forming a narrow wedge-shaped groove, into which the grain, garlic, &c., is thrown by the radial wheel, when the separation ensues, as described."

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13. For an instrument for *Ascertaining the quality of Lamp Oil;* John W. Harris, Dorchester, Norfolk county, Massachusetts, September 3.

The improvement claimed consists in the oleometer scale, and in the manner of using it in conjunction with a thermometer. The scale consists of three parts, two of which are united together at their ends, and at such distance apart as to admit the third to slide between them. These are so divided as to indicate the specific gravity of different specimens of oil, and at certain degrees of temperature, which are indicated by the thermometer.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the construction of the oleometer scale, also the mode of ascertaining the quality of spermaceti oil at any particular temperature, by means of the aforesaid scale, in combination with the oleometer and thermometer, as herein set forth. I disclaim as my invention the oleometer itself."

14. For a *Cement for Covering Buildings, Floors, Steps, Sidewalks, &c. &c.;* Jacob Bump, Kirtland, Ohio, September 3.

The following are the ingredients which are to compose this cement, viz. "To one bushel of clean sand add half a bushel quick lime, one eighth of water lime, one eighth of pulverized hard stone, granite or clean gravel, half a gallon of hot tar, one pound of copperas, one pound of alum, one eighth of a bushel of furnace, or smith's cinders. Pulverized glass will answer." "The above ingredients to be well mixed together, and after one day, or more," we are told, "it will be fit for use, to be kept tempered, and to be spread like mortar."

The claim is limited to the composition of cements formed of the afore named ingredients. We can scarcely imagine a mixture more heterogeneous.

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15. For an improvement in the method of *Opening and Closing Window Blinds;* George Butterfield, Hopkinton, Merrimac county, New Hampshire, September 4.

This patent is for a method of opening and closing those window blinds which slide horizontally. A bar extends across the window, about midway of its height, which bar is embraced by plates attached to the inner edge of each half blind; each section of the blind has a rack affixed to it, which racks are actuated by the leaves of a pinion fitted in the window frame, and provided with a winch, by which the whole is operated.

The claim is to the "mode of opening and closing blinds by the combination of the bar, racks, pinion, and crank, as described."

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16. For an improvement in the *Stencil Plate* for facilitating the painting of signs, marking boxes, bales, goods, &c.; Edwin Allen, Windham, Connecticut, September 4.

Two grooved strips are joined together at their ends so as to receive separate plates of metal, in each of which is cut a distinct letter, which may be set up and changed at pleasure. The frame, with the plates, or letters, is placed upon the article to be painted, or lettered, and the brush passed over the letters, or plates. The claim is to the "combination of the perforated plates and frame, as before described, for marking boxes, bales, &c. &c."

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17. For an apparatus for *Transmitting Heat by the Circulation of Hot Water;* Angier M. Perkins, a citizen of the United States, now residing in London, England, September 4th, 1840; antidated August, 1838, date of English patent.

The patentee says—"My invention consists in transmitting, or transfering, the heat from the fire to the aforesaid water, or other fluids, by means of the circulation of water in tubes closed in all parts, and as letters patent under the seal of the United States, have heretofore been granted to me for warming the air in buildings, and also for

heating water, and other fluids, by means of the circulation of water in tubes closed in all parts, and moreover, as the circulating hot water tubes which I now propose to employ, are, in many respects, similar to those for which the aforesaid letters patent were granted. Now, I declare that my present improvements are intended to make such addition to the aforesaid circulating hot water tubes, and such alteration thereof, as shall render them more fully applicable to the several purposes before mentioned." "I claim as new the following parts of the apparatus, viz. Firstly—The combining of a force pump with the circulating tubes, arranged and combined as set forth, closed in all parts, excepting in that for the admission of water from said pump. Secondly—The supplying the tubes with water by means of a valve opening inwards, within a cistern constructed and operating substantially, as described; the water being thereby allowed to enter said tubes by its own gravity, or by atmospheric pressure, whenever a deficiency arises from either of the causes within enumerated. Thirdly—The combining with said apparatus what I have denominated the expansion, or safety valve, for allowing a portion of water to flow out of the tubes when expanded by heat. Fourthly—The employment of a portion of the circulating tubes of my system of closing tubes, to constitute fire bars, as set forth; not intending to claim as of my invention the using of hollow fire bars communicating with a steam boiler, this having been before done. Fifthly—The manner of using the expansion and contraction of one of the hot water tubes, in combination with my system of circulating tubes, as a heat governor, or regulator, whereby the fire is kept at any required degree of intensity, and the tubes at any required temperature."

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18. For improvements in the machine for *Moulding and Pressing Bricks;* Stacy Costill, Philadelphia, Pennsylvania, September 4.

This machine consists of a circular platform, with hollow trunks extending down from it to the top of a revolving plate, containing the moulds and pistons. The shaft of this revolving plate passes up through the centre of the platform, and at the top it receives, and gives motion to, a spindle, the arms of which carry the tempered clay into the hollow trunks, through which it is conducted to the moulds in the plate below. As the plate revolves, the moulds are brought under the trunks, and receive the clay, and as they move on they pass under an arm, which is jointed to the shaft of the plate, and which, by a catch, becomes united to, and moves around a portion of the circuit with the mould, thus constituting its top. During this portion of the circuit the piston is forced up against the arm, or false top, by passing over a circular cam below the plate, and as soon as the brick is pressed the catch disengages the arm, which is carried back by a spring to the side of one of the trunks, to be ready for the next mould; as soon as the mould is relieved of the arm, the piston is forced up by an elevation on the cam, which discharges the brick. There may be any number of moulds and trunks, there being one arm for each trunk.

The claim is to "constructing the platform with vertical trunks, in combination with the revolving spindle. Also the movable arm, in combination with the revolving plate and stationary cam, (which disengages the arm from the mould,) the arm being connected to the plate, and revolving with it while the brick is being pressed, and being detached from it as soon as the pressure is completed, as described."

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19. For an instrument for *Delineating Maps, Charts, &c.;* Amity Bailey, Newburg, South Carolina, September 4.

This instrument consists of a parallel ruler attached to a ring, which revolves with a graduated circle, divided into degrees, and parts of degrees. Each end of one of the rules is attached to the ring, the other being at liberty.

The claim is confined to the "parallel ruler, in combination with the ring and graduated circle," for the purpose, and in the manner described.

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20. For an improvement in the *Paddle Wheel for Propelling Boats;* Francis W. Stevens, Chigwell, Essex county, England, September 5.

This patent is obtained for an improvement on that kind of paddle wheels which has the floats inclined at an angle of from thirty to sixty degrees; the improvement consists in a method of adjusting and changing the angle at any time. Each paddle is affixed to, and revolves on a radial axle, the outer end thereof being supported by a ring. The mode of attaching the paddles to their radial axles is by boxes, so as to allow the paddle to revolve; but when the proper and desired angle has been attained, the boxes are to be screwed tight; the outer angles of the paddles on each side are then jointed to a ring, or a series of braces, so as to retain them at the desired inclination.

The claim is to the "arrangement of the wheel, and of the floats, or propellers, by which their adjustment is effected, in the manner, and for the purpose described."

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21. For a mode of *Cutting Grass under Water;* Jacob Hinds, Hindsborough, Orleans county, New York, September 5.

Two scythes are attached by their heels to a bar of iron, which forms a handle—the scythes diverge in nearly opposite directions, so that their points will be about six feet apart. The handle is held by a person at the stern of a boat, the scythes dragging on the bottom, and as the boat moves they cut the grass.

Claim.—"I do not claim to be the inventor of the scythe, but what I do claim is the connecting of two scythes at their heels, and to a bar of iron, &c., for the purpose, and in the manner described."

22. For an improvement in *Door, and other Locks;* Augustus Prutzman, Philadelphia, Pennsylvania, September 5.

In this lock the same bolt is used for a spring latch and lock bolt, and when employed as the latter it is shot out farther than when used as the former. The bit of the key contains a set of levers, or tumblers, operated upon, and thrown into their proper position by a slide, or slides, actuated by a small additional key, which enters the barrel of the main key. Each lever is provided with a notch corresponding with a notch in the bit of the key, which latter cannot turn until, by the proper application of the small key, they are all made to coincide.

The bolt, when employed as a latch bolt, is actuated by a right angled lever, on which the cams of the knobs severally act, and when the bolt is to be thrown back it acts against one end of the tumbler, which is jointed to the bolt, so that as the tumbler is forced back by the lever the bolt must follow; but when the bolt is shot forward as a lock bolt, the end of the tumbler cannot be acted upon by the lever, and hence the knobs have no effect upon it.

Claim.—"What I claim therein as constituting my invention, and desire to secure by letters patent, is the manner in which I have constructed, arranged, and combined the slides and safety levers contained within the parts which I have denominated the barrel and bit, so as to be operated upon respectively by the offsets on the end of the key, by which the notch in said levers are made to coincide with the notch in the bit, thus allowing the bit and barrel to be carried around by means of the key, and the spring bolt to be carried forward, or moved back, as a lock bolt." "I also claim the particular arrangement of the parts which operate upon the bolt as a spring bolt, in combination with each other; said combination consisting of the double, (or right angle,) lever, acted on by both of the cams, or fallers, of the respective knobs, said lever acting upon the bolt through the intermedium of the tumbler, the whole combined and operating substantially in the manner set forth."

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23. For an apparatus for *Containing and Preserving Meat in Market;* Adam Letzer, Baltimore, Maryland, September 5.

This apparatus consists of a refrigerator of the usual construction, having within it two zinc tubs for salting meat, and a bench and "block" placed on trucks, so that when not used it can be wheeled up against the refrigerator, and the two locked together. What the patentee calls a block is a bench, boarded up all around, except on the side towards the refrigerator, and within this the scales, tools, &c., are placed. The claim is to the "combination of the refrigerator, zinc salting tubs, and motive block, for the use of victuallers at the markets, or other places."

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24. For a *Locomotive Cylinder Printing Press;* Charles J. Carr and Andrew Smith, Belper, Derby county, England, September 10.

In this press the form of types is placed upon a permanent bed, and a roller passes over it to give the impression. The roller has its gud-

geons in boxes working in a sliding frame, each end of which is provided with ink-spreading rollers, which receive the ink from an inking apparatus at each end of the machine, when the roller stops, preparatory to returning. The paper is fed in by a system of threads, a delivery board, receiving roller, &c., which conduct the paper between the impression roller and the ink-spreading rollers. There is a peculiar arrangement for registering; but as the whole could not be clearly described within the limits of a notice, and as the claims refer to, and could not be understood without drawings, we will merely add that the claims are limited, first, to the peculiar arrangement of parts for supplying, conducting, and delivering the paper; secondly, to an improvement in the inking apparatus, by which it is adapted to the peculiar structure of the machine, and thirdly, for an arrangement of the parts for effecting a register, as in book, or other work.

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25. For a method of *Uniting Canal Boats when made in Sections;* Robert Frazer, Waynesburgh, Mifflin county, Pennsylvania, September 10.

The boat is made in sections, each section being water-tight. The sections are to be united together two abreast, and three in a line, by means of iron yokes, which embrace the bows and sterns, and by eyes and staples for the middle sections. The bow and stern sections are so formed that when two are put side by side they constitute a proper bow and stern.

Claim.—"What I claim, and desire to secure by letters patent, consists first in placing the boats two abreast; and second—the mode of fastening the sections together when floating, by the yokes and screws, as described."

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26. For an improvement in the *Brake for Railroad Carriages;* Peter J. O. Conway, Philadelphia, Pennsylvania, September 10.

This brake consists of a shoe which is to be pressed against the tread of the wheel and the rail. It is suspended to a spring bar of metal which is attached to the frame of the carriage, and curved over the wheel. The brake is pressed against the wheel and rail by means of a lever jointed to it, and extending up so as to be within the reach of the tender, and when liberated it is drawn up by the spring. Claim—"I do not claim to be the inventor of a brake, or drag, in which the shoe presses against the road and the periphery of the wheel at the same time, this having been known and used before, but I do claim as my invention attaching the shoe to a spring bar, in the manner, and for the purpose specified."

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27. For an improvement in the *Spark Arrester;* Leonard Phleger, Philadelphia, Pennsylvania, September 10.

Outside of the common chimney is a casing extending from the top of the boiler to about eighteen inches above the top of the chimney, the lower half being cylindrical, and the upper spreading out

conically, leaving a space between the two, which is occupied by a perforated case, the lower portion of which is cylindrical, and the upper part conical, to correspond with the outside casing, excepting about a foot of the upper part, which is cylindrical, and not perforated. The top of the arrester is closed, excepting a hole in the middle, equal in diameter to that of the chimney, which opening is provided with a conical cover, so hinged to it as that when closed the apex of the cone will be downwards, and immediately over the centre of the chimney. The bottom of the perforated tube extends to within a foot or two of the bottom of the chimney, where the space between it and the outside casing is closed by a plate, and the space between it and the chimney is left open. From the space between the chimney and the outside case, below the perforated tube, an elbow pipe extends to a box for the reception of the sparks. The outside casing is provided with a number of elbow pipes of different lengths, opening into the space between the outside casing and the perforated tube above and below, there being two sets, one long, and one short.

The patentee thus describes the operation. "When the engine is in operation the cover is to be fastened down by means of a loop on the end of a rod. The operation will then be as follows. After the heated air, sparks, and steam, have passed up the flue, or chimney, the direction of the draught is turned downwards, between the chimney and the perforated cone; the sparks have but little tendency to pass through the perforations, but are driven down, with a portion of the steam, into the space, and thence through the elbow pipe into the receptacle, where, by the closeness of the receptacle and the action of the steam, they are soon extinguished. The gaseous products of combustion pass through the perforations into the flue space surrounding them, and through this, and the double elbow pipes, into the atmosphere. What I claim, &c., is the forcing of the sparks to descend between the flue and the perforated cone into the space, and thence through the pipe into the spark receptacle, in the manner, and in consequence of the combined operation of the respective parts, constructed as set forth."

"I also claim the forming of the flue space on the outside of the perforated cone, constructed as described, by combining with the space between said cone and the exterior case, a number of pipes, or tubes, in the manner, and for the purpose set forth."

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28. For an improvement in the *Corn Cultivator;* Noah Barnes, Easthampton, Suffolk county, New York, September 10.

This improvement in the cultivator consists in a long share, which extends from a point where the coulter and a land-side are united, to the back; the land-side and share forming an acute angle. The two consist each of a narrow bar of iron, the latter being sharp at one edge. They are attached to a triangular frame, one side of which projects sufficiently beyond the triangle to form the beam. To the back piece of the frame, which forms one side of the triangle, and to an intermediate cross piece, teeth, similar to harrow teeth, are at-

tached. The land-side, or bar, is placed under that side of the triangular frame which forms the beam. The claim is to the "combination of the share, teeth, and frame."

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29. For an improvement in the *Alarm for Time Pieces;* Benjamin Knight, Slatersville, Providence, Rhode Island, September 10.

This alarm is to be started by a detent on the arbor of the minute hand, which, at every revolution, lifts a lever, to which is suspended a rod, having a hook at its lower end that catches on to the teeth of a wheel, and at each operation carries it around one tooth. This wheel has twenty-four teeth; and on its face it is divided into as many parts, marked in two series, from one to twelve, there being a hole on the face to correspond with each division, into which a pin may be inserted. The pin is inserted in the hole corresponding with the hour at which it is to give the alarm. The wheel is turned one notch at each hour, and at the given hour the pin lifts a lever, and this a second lever, which is weighted, and is connected by means of wires and bell cranks with the bell, which is to be rung.

The claim refers to the drawings, and is limited to the arrangement and combination of the parts consisting of the detent on the arbor of the minute hand, the rod which actuates the notched wheel, the latch lever, and the weighted lever, as described.

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30. For a machine for *Cutting Staves;* Cephas Manning, Acton, Middlesex county, Massachusetts, September 10.

In this machine the knife is curved in the direction of its cut, so as to cut staves suited to the diameter of the barrel; the knife is attached to two blocks, one at each end, which slide in curved grooves in the frame, instead of being attached to two heads working on an axis; the knife is actuated by a lever. The claim is to the arrangement above described.

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31. For a machine for *Dressing Cotton Waste and Rags,* previous to the same being reduced by the cutting machine and common duster; Emery Smith, North Sudbury, Middlesex county, Massachusetts, September 10.

This machine consists of a cylinder, with two rows of double pointed teeth on opposite sides, so arranged that the teeth in one row shall be opposite the spaces between the teeth in the other row; these teeth are all curved in the same direction. A row of wire teeth projects from the side of the case in which the cylinder revolves, and these are so arranged that the point of each tooth will pass between the forks of the teeth on the cylinder as it revolves. A wire concave is placed below, sufficiently low to avoid the teeth on the cylinder. The cylinder is provided with two fast and loose pullies, and with two straps, by means of which it may be made to revolve in opposite directions.

The claim is to the cylinder with angular forked teeth, in combination with the teeth in the case and the wire concave.

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32. For a *Sugar Mill;* Nathan Sargent, Cambridge, Middlesex county, Massachusetts, September 10.

The sugar is ground by a cylinder armed with rows of teeth which run spirally around one half of its circumference in one direction, and in the reverse direction on the other half. The teeth are thus arranged to enable a scraper to scrape away the sugar which adheres to the surface of the cylinder between their rows; this scraper is placed in slides below the cylinder, and is notched, to correspond with the rows of teeth. As the cylinder revolves, the teeth come into contact, in succession, with the whole surface of the sugar in the hopper, and the scraper removes that which adheres between the rows of teeth, said scraper receiving a reciprocating motion from the teeth. Were these arranged in rows in the direction of the circumference, they would not act on the whole surface of the sugar, and if they were arranged in continuous helices the scraper could not act on the surface of the cylinder between the rows of teeth.

Claim.—"I claim a cylinder having its teeth disposed in advancing and receding helices, in combination with a scraper."

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33. For an improvement in the manner of *Attaching Glass Knobs to their Sockets;* Francis Draper, East Cambridge, Middlesex county, Massachusetts, September 10.

The lower part of the knob is made conical, the larger part thereof being towards the socket, a strip of metal is bent around it, and the ends soldered together, and attached to the glass by cement, or other means. This part, thus surrounded with metal, is put into the metallic socket, and the two are then united by soldering.

Claim.—"I claim as my invention, connecting the glass knob to the socket, through the intervention of a conical metallic ring affixed to, and surrounding the lower part of the knob, and soldered to the socket."

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34. For improvements in the mode of *Pressing and Finishing Straw Hats and Bonnets;* William Chaplin, City of New York, September 10.

The top, crown, and brim, of the hat are pressed separately, and for this purpose, press, or dye, blocks of wood, of the proper form, and previously moistened, are used in connection with polished metal matrixes, provided with heaters. For the crown the matrix and block are conical, as are also those for pressing the rims and fronts, and for the top, of any form to suit the fashion. The block and matrix are placed, with the article to be pressed between them, in a hand press, very similar to the common hand printing press.

Claim.—"First—the application of countersunk heated metal disks,

for pressing and finishing the crown tops of hats and bonnets, in combination with the dye block, as described."

"Second.—The mode of forming the conical matrixes and heater boxes with heaters, and the combination of the same with the conical dye block, when such combination is applied to pressing and finishing the sides of bonnet, or hat, crowns, as described."

"Third.—The employment of the conical dye block for pressing the brims, or fronts, and also the employment of paste board, to give equal pressure, as described."

"Fourth.—The mode of forming the conical matrixes and heater boxes with heaters, for pressing bonnet, or hat fronts, or brims, and the combination thereof with the curved conical dye block, when such combination is employed for the purpose of pressing bonnet, or hat fronts, or brims, or articles of a similar nature, made of vegetable substances, as herein described."

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35. For a *Machine for Cutting Staves;* Oliver Sheldon, New Marlborough, Berkshire county, Massachusetts, September 10.

The improvement is on that kind of stave cutting machines, that cut by means of a knife attached to two heads on a shaft, the knife being curved in the direction of the cut, so as to give to the stave the proper form for the diameter of the barrel; the improvement consists in attaching to two arms on the shaft, to which the stave cutting knife is attached, two sets of cutters for forming the champher and groove at each end of the stave, and for cutting off their ends. The claim is confined to these cutters in combination with the revolving knife for cutting the stave.

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36. For an improvement in the *Machine for Cutting Staves;* Caphas Manning, Acton, Middlesex county, Massachusetts, September 14.

This machine cuts a stave in a manner similar to that noticed in the preceding article, but without the improvement therein mentioned as the subject of the claim. The improvement claimed in this patent consists in combining with the revolving cutter for cutting staves a mode of working the carriage to feed the block up for every stave cut. In the machine described two cutters are used.—The block of wood is properly attached to a carriage by means of dogs—the carriage has a rack under each end into which two pinions on a shaft mash, and is so connected, by means of suitable gear, with the shaft of the cutters that the block is fed up, after one knife has passed through the wood, to receive the cut of the other knife.

The claim is to the "arrangement of the knives in combination with the arrangement of machinery for moving forward the carriage as the staves are cut."

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37. For an improvement in the *Horse Power;* Charles Hibbard, Guilford, Stafford county, New Hampshire, September 14.

Two vertical shafts placed at a considerable distance apart, have a

band or rope passing around them, to which the horse, or horses, are attached, so that they draw in a straight line except in passing around the wheel at each end. From one of the shafts the power is communicated by means of bands and band wheels to the machinery to be driven. The claim is confined to this device.

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38. For an improvement in the *Two Wheeled Carriages, called Cabs;* John Page, New York city, September 14.

The improvement in this cab consists, first, in carrying a bent axle along the sides and around the front or back of the body; and when carried around the back, in bending it down so as to pass under the door, and in attaching the shafts to the bent part of the axle, and connecting the body of the carriage with the bent axle by means of the springs only; and secondly, in arranging the seats diagonally and in having the door in one of the corners so that two persons can sit in a less space than when the seats are ranged entirely across.

Claim.—"What I claim is the manner in which I have combined and arranged the bent axle, the shafts, the springs and the body of the carriage, or cab, with each other, the bent axle being carried either in the front of or behind the body, as herein set forth. I also claim in combination therewith, the manner in which I have arranged the seats and the door, by placing the former in opposite corners and the latter on one side, as set forth."

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39. For *Key Bands for Tobacco Casks;* James M. Talbott, Richmond, Virginia, September 14.

This band has a plate on one end with a mortise through which passes a tongue attached to the other end of the band—the tongue also has a mortise in it through which passes a key by which the band is drawn tight after it has been put on the cask.

Claim.—"What I claim as my invention is constructing the key band with a mortise plate in combination with the tongue and wedge."

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40. For a machine for *Extracting Stumps;* Lewis and Charles Howard, Reading, Steuben county, New York, September 14.

A chain made fast to the stump is attached to, and winds on a windlass or shaft on which there are two ratchet or rag wheels which are actuated by two hands worked by combinations of levers, there being three levers in each combination. At the end of the frame of the machine towards the stump, two large pieces of timber called anchors, and properly shod, are hung by hinges, and these are forced into the ground and prevent the machine from being drawn towards the stump.

Claim.—"What we claim as our invention and desire to secure by letters patent, is the manner in which we have arranged the levers, in connection with the machine, and their further combination with the bands, wheels, anchors and chain."

41. For improvements in the *Floating Dry Dock;* John L. Gilbert, New York city, September 19.

This floating dry dock is so constructed that it may be used either for the purpose of repairing vessels or for floating them over bars or shoals. It is constructed with water tight cases, or trunks, on each side of the body, or floating chamber, of the dock, and these are divided transversly by means of water tight bulkheads; the whole of these are connected with each other, and with a pump well, by means of pipes governed by cocks, so that water can be let into, or pumped out of any or all of them by means of a steam engine, which may also be used for pumping the water out of the body of the dock, and for propelling it when used for floating vessels over shoals, &c.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of the body of the dock in which a ship can float, with water tight trunks, or tanks, at the sides separated by water tight bulkheads, for the purpose and in the manner set forth."

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42. For improvements in the *Cooking Stove;* James Still, Zanesville, Muskingum county, Ohio, September 19.

In this stove the flue passes over the top and under the bottom, and up the back of the oven, the draught being caused to pass along both flues at the same time by extending the top plate back so as to divide the collar, which receives the stove pipe, into two parts. A hole is made in the bottom plate of the stove opening into the bottom flue and is provided with an ash box into which the dust falls in cleaning out the stove.

Claim.—"First, the mode of forming a double draught by extending the top plate of the oven back so as to divide the collar to which the smoke pipe is attached into two parts, for the purpose of allowing a draught above and below the oven at the same time, as described. Second, constructing a flue under the oven with an opening at its bottom and adapting thereto a movable box, as set forth."

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43. For a *Machine for Cleaning Grain;* Edward Bradfield, Rochester, Monroe county, New York, September 19.

Within a cylindrical casing, formed of wood or iron ribs, and of wire gauze, what the patentee denominates a beating cylinder, is made to revolve; this cylinder is constructed by extending arms radially from a vertical shaft at its middle and near its two ends, by affixing a hoop or ring to the ends of these arms, by covering the two end hoops with wire gauze, and by securing to the edges of these hoops four metallic plates, having their edges turned at right angles so as to stand out radially; these plates have teeth cut on them, and are so tempered as to give them elasticity. Between each of these plates there is another plate running from end to end of the beater cylinder, its edge standing out radially and as far from the center of the shaft as the point of the teeth on the first named plates. A plate of metal is placed on the shaft, below the lower disc, or end, which

plate is made to form vanes, which force a current of air up into the beater cylinder. The grain is fed in at the top, and in descending it is operated upon by the beaters and the current of air.

Claim.—"What I claim as my invention and desire to secure by letters patent is, the constructing of the revolving cylinder with elastic teeth, as herein set forth; also in combination with the above, the radial plate at the bottom of the machine, in which is combined their self regulating power, so as to effect the greatest possible good for the purpose intended."

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44. For improvements in the *Coffee Mill;* L. R. Livingston and Calvin Adams, Pittsburg, Pennsylvania, September 25.

This mill is of the old fashioned kind, with a nut revolving in a shell, and the improvements claimed are three in number. The first consists in a mode of casting the hopper, shell and arch piece in one piece. From that part of the hopper where the shell commences three pieces rise, approaching each other until they unite in a collar for the spindle to work in. The second, is the mode of attaching the mill to a table, or shelf, by means of a projecting plate, cast with the hopper, and with jogs on its under side to stick into the wood, and a hook which catches against the underside of the table, or shelf, the shank of which passes through a hole in the plate, and receives a nut on its end by which the plate and hook are drawn tight together, embracing the table or shelf between them. The third improvement is in a method of regulating the cut of the mill—this is effected by passing the spindle of the nut, or cylinder, through the collar of the arch, and instead of letting the handle rest against a shoulder on the spindle, it bears on the top of the collar—the thumb nut which screws on to the end of the spindle, draws the grinder up, in consequence of the handle resting on the collar of the arch. Or the same thing may be effected by attaching the handle to the spindle permanently and having a thumb screw to pass through the handle and rest on the collar of the arch. The claim is confined to these devices.

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45. For an improvement in *Door Locks;* Peter Rogers, Philadelphia, Pennsylvania, September 25.

The patentee says—"the improvement consists in the manner in which I construct and combine the spindle and knobs of the spring bolt with the fallers, or followers, which operate upon the lever and retract the bolt so as to simplify the structure of this part, and improve its action. I construct the inside faller, or that which is next to the lock plate, with a hollow barrel, or cylindrical socket, which projects out from the face of the lock plate, upon which barrel, or cylindrical socket, I fit the inside knob of the spring bolt. The knob spindle is made cylindrical where it passes through the inside faller and into said barrel, and has a groove turned in it to receive the point of a screw which passes through the inner knob, and through the barrel, attaching them together, and holding the knob spindle in place."

Claim.—"I claim the constructing, combining, and arranging of the

socket, the inner faller and the inner knob, in the manner and for the purpose herein set forth, so that the two knobs may act independently of each other. I do not claim the mere making of the inner knob to act upon the spring bolt independently of the outer knob, this having been done in other modes, but I limit my claim to the effecting this object substantially in the manner made known."

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46. For a *Self Acting Mule for Spinning Cotton;* Daniel P. Lapham, administrator of Benjamin Lapham, Adams, Berkshire county, Massachusetts, September 25.

This is of necessity a complex machine, the description of which runs through thirteen pages of folio, with numerous drawing. An attempt to give even an account of its characteristics would lead us far beyond our limits, and without the aid of drawings it would be useless to attempt a description of it. We are under the necessity of omitting the claims as they refer throughout to the drawings and could not be understood without them.

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47. For a *Cotton Press;* James A. Potter and James E. Kelsey, the former of Providence, Rhode Island, and the latter of Poughkeepsie, New York, September 25.

This press consists principally of two endless chain platforms somewhat similar to those made for endless chain horse powers, these platforms are so arranged, one above the other, that at one end they approach more nearly together than at the other:—their distance apart being regulated at pleasure. The bale which is to be repacked is received between them at the end where they are farthest apart, and in passing through as the platforms revolve, it is compressed. This machine is intended only for repressing bales of cotton, hay, &c., for the purpose of making them occupy less room in stowing on board ship—and it is made portable so that it can be taken to a wharf when a vessel is to be loaded.

Claim.—"What we claim as our invention is the employment of two revolving endless chain platforms so constructed as that they shall be nearer together at one end than they are at the other, &c., as described."

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48. For improvements in the *Cooking Stove;* Samuel L. Chase, Woodstock, Windsor county, Vermont, September 25.

In this stove there are two, three, or more ovens, and these are arranged two in height with a flue between them. The draught passes out from the fire chamber into the flue between the top and bottom ovens, then over the upper oven, or ovens, thence down one end to the flue under the lower oven, or ovens, thence to a rarefying flue under the fire chamber (to insure a draught) and out at the exit pipe. The hearth in front of the fire chamber is sunk, and is provided with bars, for coal, and holes below the bars for draught, it is also provided with a cover, having holes for boiling, &c., which is hinged so as to swing

off and on. That part of the cover on the sunk hearth which runs along below the door of the fire chamber is notched, and the bottom of the side door is provided with an inclined piece, the two forming a flue, from the coal undergoing combustion in the sunk hearth. The cover of the hearth may be made in two parts, each half being hinged so as to swing off on the two sides of the stove.

Claim.—"Having thus fully described the nature of my improvement, and shown how the same is carried into operation, and having in so doing shown and described many parts and devices, of which I do not claim to be the inventor, I now proceed to state what I do claim, and desire to secure by letters patent, viz: first, the manner in which I have combined and arranged the flues, including the rarefier as set forth, that is to say the admitting of the heated air from the fire chamber into the flue between the upper and lower ovens, conducting it thence through the flue above the upper oven, thence through the flue at one end to the flue under the lower oven, thence into the rarefying flue under the fire chamber, and thence into the exit pipe, all as herein made known. Secondly, I claim in combination, the arrangement of the respective parts of the hearth for boiling and other cooking operations, which arrangement consists of the sunk hearth furnished with the bars, the openings for the admission of air, the swinging hearth, and the flue formed by the notch in said hearth, and the sloping projection at the lower edge of the furnace door, as described."

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49. For a *Cot, or Cross Bedstead Sofa;* Girard Sickles, Middletown, Middlesex county, Connecticut, September 25.

The following is the claim on which this patent was granted, viz: "What I claim is the contrivance of converting a common cot, or cross bedstead, into the shape of a sofa, or settee, and vice versa, by means of an additional joint in the upper part of one of the cross stanchions, or legs, at each end of the cot, combined with arms and frontispieces, all constructed, fitted, and adapted to each other as described."

When the sofa is used as a beadstead the jointed stanchion is straight, a cloth, sacking, or leather bottom is stretched from a bar running from the upper ends of the two stanchions on one side, to the bar on the upper end of the stanchion on the other, in the manner of a common cot bedstead. When it is used as a sofa, the jointed end of the two stanchions, which are in the front of the sofa, turn down and form the fronts of pillasters; this brings the bar, to which the sacking is attached, down to the proper height for a seat, and the sacking lies in a proper curve to form the seat and back, the bar on the other stanchions being elevated by this change. The necessary means are provided for locking the parts in their proper position, and for ornamenting the article.

Specification of a Patent for an Improvement in the Construction of Railroad Switches. Granted to NATHANIEL EATON, *of Worcester, Massachusetts, on the 3rd of September*, 1840.

Be it known that I, Nathaniel Eaton, of Worcester, in the county of Worcester, and state of Massachusetts, merchant, have invented a new and useful improvement in the construction of railroad switches, called "Eaton's Improved Railroad Switch," of which the following is a full and exact description.

The improvement is applied to the railroad switch in common use, which is formed by two rails connected by transverse rods of iron, and which may be shifted from one set of permanent rails to meet those of a different track, by means of a lever. The improved switch is made with two, or more rails, to accommodate to the number of tracks or diverging rails, which may be used. It may be placed on a platform of wood, or metal, over the superstructure of the road, or may have the rails connected together by iron rods, with screws and nuts to hold each of the rails in their places, and to adjust them in case of any change of position, occasioned by accident, or by the variation of temperature. The improved switch is constructed with two, or more rails. On the outside are placed two rails, commencing at the end next to the chair in which they rest, or the hinge by which they are shipped; these rails are formed like the common rails of the road; they are straight, until they reach about to the middle of the length of the switch, and are then bent slightly outwards. Within these outer rails, and at such distance within them as to admit the passing of the flanch of the car wheel, is fixed another rail; this is fastened to the head of the switch by a bolt, on which it turns as upon a pivot; it is formed of the usual thickness and size of the road rail, for about three or four feet from the head, and then tapers on the side to an edge, or point, having a wedge shape. This is called the safety rail; and is of such length, and tapers in such manner, as that when the small end is pressed against the outer rail, where that curves outward, that the inner surface of the safety rail forms a straight line with the permanent track. This safety rail is pressed strongly against the inner face of the outer rail by a spring placed so low beneath the upper surface of the rail as to lie beneath the flanch of the car wheel, or it may be bolted to the outer rail, or so secured by the other attachment as to act against the safety rail, and to bring it in contact with the outer rail. The safety rail may slide on smooth iron plates, or be moved on friction rollers, or on rods of iron connecting the rails together.

On the inside of the safety rail is fixed another rail, shaped like a wedge, tapering on the sides to an edge, two or three feet long, and continuing the permanent rail. This rail is bolted at the head of the switch; beyond it, extending towards the hinge end of the switch, is

a guard rail of the common form, to guide the wheels on the track, and prevent their striking against the edge of the safety rail.

The construction of the improved switch, which has been described, is fitted for only two permanent tracks; but the switch may be adapted to any required number of tracks, by increasing the number of rails on the switch, and providing a safety rail and spring for each additional set of rails, in the manner before described.

The switch is moved and regulated by the lever and rod applied to the common switch.

In the use of the improved switch the safety rail is placed against either of the main, or diverging tracks of the railroad, and at least two of the permanent rails are covered. As the cars proceed in the direction from the hinge to the head of the switch, they will be directed on the track covered by the safety rail, and will be prevented from running off from the rails; when they move in the opposite direction, they must be carried upon the permanent rails, because the end of each of those rails is covered and continued by the switch rails. Although the switch may not have been moved, the flanch of the car wheel, if running on the outer rail, will move the safety rail so far as to admit of the free passage of the cars, and after the train shall have passed the spring will restore the safety rail to its place.

The accidents which have occurred in the old mode of constructing, cannot occur in the improved mode of building switches, which has been specified; for the safety rail, adjusting itself, will always furnish a continuous line, and prevent the cars from running off from the track. Another great advantage of the safety rail is, that the cars on many diverging tracks, will be carried upon one line of rails without the care and labour of adjusting the switch for each. What the said Eaton claims, and desires to secure by letters patent, is the mode of constructing switches with a movable rail, operating by a spring, or weight, or otherwise adjusted, in the manner before described, so as to cover two, or more, permanent railroad tracks.

NATHANIEL EATON.

Specification of a Patent for a Means of Producing Adhesion between the wheels of Locomotive Engines and the rails of railway tracks. Granted to JORDAN L. MOTT, *of the city of New York.*

To all whom it may concern: Be it known that I, Jordan L. Mott, of the city of New York, in the state of New York, have invented a new and useful method, or apparatus, for the purpose of producing adhesion between the wheels of locomotive steam engines and the rails of railway tracks, by which device such engines will be enabled to overcome the resistance arising from ascending grades without its being necessary to throw any additional weight upon the wheels for that purpose, and I do hereby declare that the following is a full and exact description thereof.

My improvement consists in the combined application of moisture and of sand to the wheels, by means of which the sand may be dis-

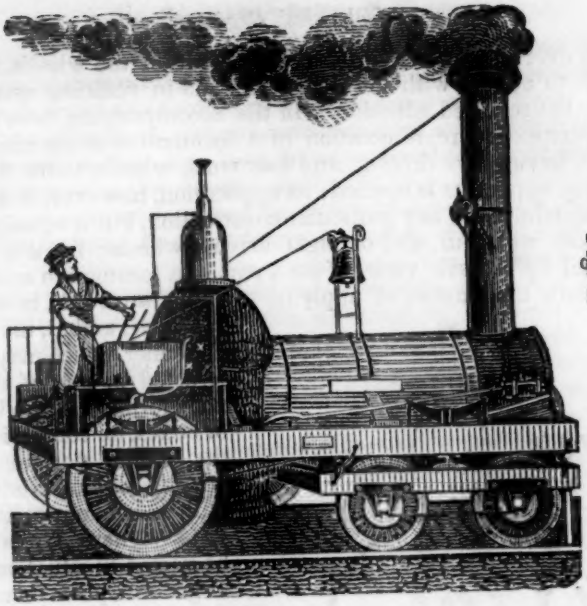


Fig. 1.

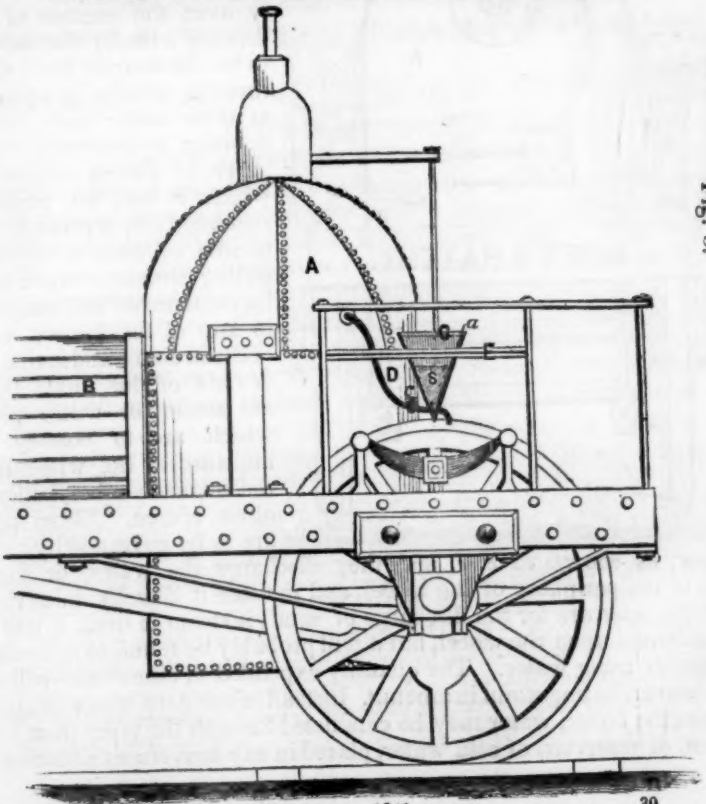
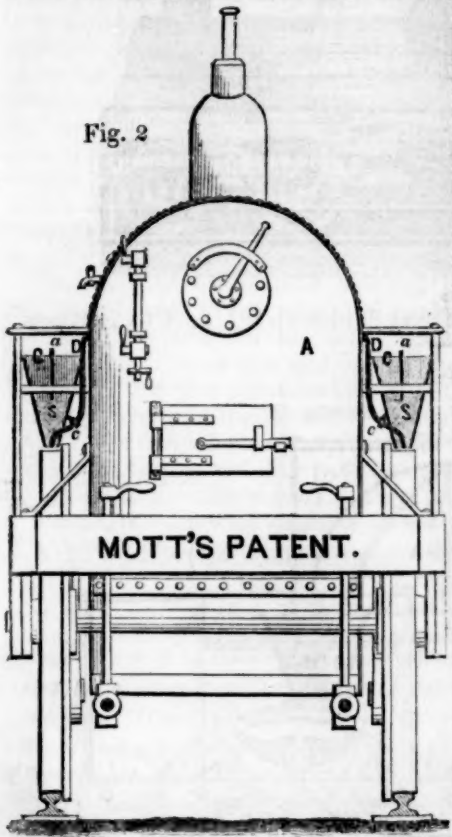


Fig. 3.

tributed over the surface of the tire, or tread of the wheels, and will be made to adhere with sufficient force, and in sufficient quantity, to produce the required adhesion. In the accompanying drawings, fig. 1, is a perspective representation of a locomotive steam engine and carriage, having two driving, and four truck wheels, to the former of which my apparatus is applied; its application, however, is not limited to locomotives of any particular construction, but is equally adapted to those with four, six, or eight driving wheels; fig. 2 is an end view, and fig. 3 a side view, of such part of a locomotive as is requisite to show the manner of applying my apparatus. A, is the steam chamber, and B, the body of the boiler, which may be constructed in any of the ordinary forms; *c*, *c*, are hoppers, or boxes, for containing sand, the lower portions, *s*, of which boxes are to be charged with this material in a dry state. These hoppers may be varied in situation, but I, in general, place them directly over the centres of the driving wheels; the sand is to be discharged from them through a tube, or opening, at their lower ends, which opening is governed by a valve, or sliding shutter, by which it can be properly regulated; *a*, represents the handle of such a valve, or sliding shutter, which may be constructed and managed in any of the known ways of constructing and managing devices of this kind; D, D, are steam, or water pipes, which are to convey the moisture to the wheel from the steam chamber, boiler, or other source. These pipes are to be governed by a stop cock, as shown at *c*, *c*, and they discharge the water, or steam, on to the periphery of the wheel, and moisten it directly in advance of the aperture for the discharge of sand; if steam is used, it will be condensed upon the wheel, but it will probably be found to economize heat by using water. The quantity expended in either case will not, however, be important in amount. Instead of using the water, or steam, from the boiler, water may be conducted through the pipes from a cistern, or reservoir, of cold water, placed in any convenient situation for

Fig. 2



that purpose. Although I prefer to discharge the sand and moisture upon the wheels, it will be manifest that they may be directed with like effect on to the rails in advance of the driving wheels, and that the combined operation of the moisture and sand will be the same, but the apparatus will, in this case, have to be extended, without producing a corresponding advantage.

Having thus fully described the nature of my invention, and shown how the same may be carried into operation, what I claim as new, and desire to secure by letters patent, is the applying of sand to the peripheries of the driving wheels of locomotive engines, in combination with the application of water, or steam, to moisten the wheels, for the purpose of causing the sand to adhere thereto, substantially in the manner set forth, and so as to enable such locomotives to ascend inclined planes, or elevations, on a railroad, in consequence of the friction produced by such application; I claim also the applying of moisture and sand simultaneously to the tops of the rails in advance of the driving wheels, considering this mode of applying the moisture and sand as a mere modification of the general principle upon which the utility of my invention is dependent.

JORDAN L. MOTT.

Practical & Theoretical Mechanics & Chemistry.

Memoir on the Preservation of Timber. By M. A. BOUCHERIE, M. D.

[CONTINUED FROM PAGE 286.]

Is the Penetration always complete?

In the white woods we find a central tube of variable diameter, which resists impregnation; in the hard wood, it is the most central part of the heart which remains in its natural state. This fact is worthy of attention, and appears to me, fruitful in results, both in regard to practical applications, and to physiology.

In the white woods, this central part is known to those who work in wood, as presenting the least resistance, and being the most easily decayed. It does not become impregnated, because it has no longer a circulation, or life; it is dead wood, placed in the midst of wood perfectly alive.

Many observations confirm this view of the subject, which may lead us to learn more accurately the qualities of wood. Thus I have found that this non-impregnation appears elsewhere than at the centres of the stems. It is found disseminated in all possible forms, and to a variable extent, in different parts of the same stem. Alongside of a band, the fibres of which are perfectly impregnated, will be found another band, whose fibres are not affected, and this occurrence is very often repeated in the same stem. What is the cause of this? A little attention will suffice actually to show it to us in the greater number of cases, and to deduce it by reasoning when it is not evident.

These accidents are always due to some obstacle in the circulation, and almost always, at the base of the bundles not impregnated, we

will find a knot, or a decay. No movement can then be produced during the life of these parts of the stem, and it is not astonishing that we cannot succeed in impregnating them after the tree is cut. It is, I repeat, dead wood, which must be destroyed more rapidly than the wood around it, since it has been for a long time subject to the influences which destroy all organic substances. I am aware of the boldness of such an opinion, but I also see how curious will be the experiments made to confirm, or destroy, it. I call attention to it.

This irregularity of the penetration gives rise to very remarkable peculiarities; I have pieces of wood which owe to it the appearance of marble.*

As to the non-penetration of the most central parts of the heart of oak, elm, &c., I consider it also as a proof that the circulatory movement has for a long time ceased there; it is again, dead matter, placed in the midst of wood full of life. A number of persons will contradict this proposition, for the heart of oak is generally considered as the part of the wood which presents the greatest resistance.

In order to answer this objection, I will make one remark, and quote a single fact.

The fact, I owe to M. Emery, ingenieur en chef des ponts et chaussès, he informs me that in a structure of oak wood, he observed that all the pieces, in other respects sound, or nearly so, upon their exterior, were completely worm-eaten in their central parts, and that this alteration always occurred in oak wood under the same circumstances.

The remark is as follows; in the ordinary distinction which we draw between the sap wood and heart of oak, we ground it upon the difference of colour, which is presented by a section perpendicular to the axis. All that is white, or nearly so, is sap wood; all that is dark, is heart wood. Admitting the distinction, and drawing it in the same way, there is no doubt but that the sap wood is far more alterable than the heart; but the difference is not the same when we ground it upon the fact of penetration, and consider as sap wood all that is impregnated, and as heart, all which resists. The sap wood then approaches much nearer to the centre, and constitutes three-fourths of the mass of the wood.† And it may well be the penetrable substance alone, in which the circulatory movement existed, which presents this resistance to alteration; it is probably for want of careful observations that it has been admitted that the central part of the heart possesses properties which do not exist in the intermediate and living parts which are interposed between the heart and the sap wood. In

* This central portion, this heart of white woods, varies according to age, in regard to the volume of the tree which it occupies. In trees of great age, it is larger in proportion, than in those more young. I experimented upon a pine tree eighty-five years old, in which it represented one-fifth of the cube of the wood.

† All hard woods do not resemble each other, in regard to the volume of impenetrable heart wood, as compared with the parts which it is possible to impregnate. Thus, in sea-side oaks, experiment has proved that we may succeed in penetrating three-fourths of the mass. I have found other oaks, growing on the same soil, of which not more than one-ten h could be impregnated. The season in which they were cut, it is true, was not the same, but I have not yet been able to determine whether the season was the only cause of the differences.

this case also, in order to form a definite opinion, we must have recourse to new experiments.

I will close this enumeration of all the most remarkable facts connected with the penetration of wood, by quoting an experiment originating in this course of study; it appears to me to contain excellent elements for the determination of the proper season for cutting wood, for the purpose of preserving it.

It is known that this cutting always takes place in winter; the recommendation to cut wood at this season is founded upon the false idea that trees cut in winter contain less juice than those cut in other seasons. This practice has continued for ages, and nothing indicates a disposition to abandon it; yet I believe it to be essentially pernicious to the preservation of wood, and I think that cutting them in summer, or better still, in autumn, would be infinitely preferable. The following is the experiment, which justifies the boldness of this opinion.

If after having cut a branch, or a small tree, we adapt to its extremity an U shaped tube, having long limbs, and one-fifth filled with water, we will remark a strong sucking action exercised upon the air interposed between the bottom of the branch and the surface of the water. This surface slowly rises, and finally attains a great height, at which it remains stationary when the force of aspiration is exhausted. I have found, to my great astonishment, that the volume of air absorbed is nearly equal to the cubic capacity of the branch itself, when the small twigs had been trimmed off.

This experiment appears to me to speak for itself; a great quantity of air evidently goes to replace the water which escapes from the leaves. Hence I conclude that if the cutting took place in a season when the sap is in movement, and if, contrary to the usual practice, the tree were not deprived of its foliage, this natural and abundant introduction of dry air into the sap vessels, would hasten the action of drying in an extraordinary degree.

Upon Hardness.

I will finish my remarks upon the employment of pyrolignite of iron, by mentioning that it not only insures the preservation of timber, but that its presence adds to its density, and seems to exercise a peculiar action upon the ligneous fibre. It hardens it to such a degree that the wood, when prepared, presents to cutting instruments, or any other mechanical force, a resistance at least double that of its natural state. Every workman to whom I have given wood of this kind to work has confirmed this observation, (which, I think, is of importance,) by their reiterated complaints of the difficulty of working it.

Of the Flexibility and Elasticity of Wood.

After having completed my researches upon the preservation of timber, I turned my attention to its flexibility and elasticity.

These qualities are particularly sought for in naval constructions; the woods which possess them and which preserve them for the longest time, offer such guarantees of durability and service, that the ship-

builder does not hesitate to pay, for masts of northern fir, five times as much as they would cost if made from our Pyrenean firs, or the pines of our *landes*. If, leaving this important application, we examine the circle of the arts which employ wood, we shall find, almost at every step, the necessity of this flexibility and elasticity, which timber looses more and more as it dries.

I therefore sought the means of developing these qualities, in all degrees, in timber without impairing its strength, so that, independently of those conditions of external moisture which preserve them, they might remain without being subject to any of those influences which cause their disappearance.

Nothing but the study of the causes which produce these excellent qualities, could conduct me to the knowledge of those substances, the introduction of which into the vessels of the wood, would either maintain them or communicate them artificially. I therefore proceeded in this natural way, and confirming every observation by farther experiment, I was led to perceive—

First—that the flexibility and elasticity of wood are generally proportional to the moisture which it retains, that these qualities remain only so long as this moisture continues, so that they may serve to prove its presence, even in the dryest wood, and after long service.

Secondly.—That in numerous exceptions to this rule, they appear to depend upon the organic constitution of the wood.

Thirdly.—That in certain circumstances we may attribute them probably to the composition of the wood with reference to the alkaline salts which it contains.

I have purposely neglected to enter into any scientific explanations for the purpose of justifying my opinions, which, although confirmed by numerous observations and experiments, yet require further confirmation. I am now pursuing these researches on a large scale by experiments which will require time.

I confine myself at present to the consideration of the flexibility and elasticity of wood, in reference to its relation to the moisture which it contains, and I will now point out the means to which I had recourse not only to preserve these qualities but also to augment them to a degree which was truly extraordinary. To obtain this result, it is only necessary to introduce into the wood, by means of its vital absorption, a deliquescent salt, which acts not only as an agent for the preservation of its moisture, but which seems, in addition, to produce the effect of the oily bodies, developing in the wood a degree of pliability, which it by no means exhibits when first cut.

In my first attempts I used the chloride of calcium; (muriate of lime.) This compound is cheap, and I proposed to use it in all cases; but reflecting that a great consumption would perhaps augment the price beyond a reasonable limit, I endeavoured to find a substance still less costly, and was fortunate enough to think of the mother-waters of salt marshes, a product now thrown away, which may hereafter be collected and applied to this purpose—and with another view, which I shall point out. These mother-waters are essentially composed of

deliquescent chlorides, and their production is, we may say, unlimited; they gave me the same results as the chloride of calcium.

Moreover whatever deliquescent salt we may choose, it gives flexibility and elasticity to the wood, to any degree which may be desirable. The effect is but slightly remarked with very dilute solutions, while concentrated solutions render these properties excessive. In one word these qualities are developed in proportion to the state of saturation of the liquids which we employ.

My experiments were chiefly made upon pine, which is perhaps the most brittle of woods. I saturated it with concentrated solutions, and then had it cut into very thin slips.

A slip one-tenth of an inch in thickness, and two feet in length may, without breaking, be twisted in the direction of its length, so as to form a complete helix, or may be made to describe three entire concentric circles. They return immediately to a straight line, when the force ceases to act—after having been prepared for eighteen months these properties had not diminished.

Every thing leads me to believe that these saline solutions will also insure the preservation of the wood; but for greater security I mix with them one-fifth of the pyrolignite of iron.

It was to be feared that paint or varnish could not be applied in a permanent way upon wood thus prepared, but I have convinced myself that they adhere to it with as much force as to ordinary timber.

Circumstances did not permit me to study completely and upon large timber, the comparative resistance of wood thus prepared, but the orders of the ministers of the navy and of public works, are about to furnish me with the means of commencing a series of experiments on a grand scale upon this subject. I am already prepared to assert that when in masses one and a half inches square these timbers are never completely dried under the most intense heat of the sun, not even after months of exposure; the little moisture which they lose during the day, is restored to them at night, and consequently their drying never exceeds certain limits. This fact is interesting, in relation to mast-timbers which in certain latitudes are exposed to a drying which facilitates their breaking.

I will not now dwell upon the assistance which various arts may derive from this discovery, as I wish at present to insist only upon the leading fact of intervascular penetration, and upon the general results which flow from it.*

[TO BE CONTINUED.]

* I cannot refrain from citing a fact, which seems to me to demonstrate that the liquids introduced by the vital absorption, are really enclosed in the interior of vessels, the impermeable walls of which retain them imprisoned, even after the death of the vegetable. Having abandoned to themselves some leaves of the Sycamore, fully developed, and penetrated by strong solutions of chloride of calcium, I was not a little surprised to find that during more than two months, in proportion as the contact of the air with their surface contracted their tissue, and thus tended to diminish the capacity of their vessels, they discharged by their *foot stalks alone* a portion of the matter introduced—if the vessels had been permeable, the liquid, without doubt, instead of following so long a course, would have flowed out at the point where the contraction took place. Leaves less far advanced in their development, the vascular tissue of which, consequently, did not present the same resistance, discharged themselves under the same circumstances, by all the points of their surface.

I will mention, also, that after impregnation with chloride of calcium, these leaves shewed,

Progress of Physical Science.

Deductions from Observations made, and Facts collected on the path of the Brunswick Spout of June 19th, 1835. By JAMES P. ESPY, *Member of the American Philosophical Society. Read April 15th, 1836.*

[CONTINUED FROM PAGE 280.]

From the evidence which I collected during five days which I spent on the Brunswick spout, the following important facts are clearly established.

The spout was suddenly formed about seven and a half miles west of New Brunswick, and terminated as suddenly at Amboy, about seventeen and a half miles from where it began. It traveled a little east of north with a very moderate velocity, probably not more than twenty-five or thirty miles an hour. It appeared to all persons, in whatever direction it was viewed, in the shape of an inverted cone of very dark cloud, or smoke, reaching from a dark cloud above down to the earth.

It prostrated nearly every thing in its path, which was from two hundred to four hundred yards wide; the trees on the north of the central line being thrown with their tops towards the south east, and those on the south of this line with their tops towards the north-east; while those in the central line itself were thrown nearly towards the east, or in the direction of the spout: not one instance being found of the trees being thrown with their tops outwards.

It unroofed the houses, prostrating many of their walls outwards as if by explosion, and tearing up the floors of some whose walls were left standing; and not unfrequently, it lifted frame buildings entire from their foundations.

It carried the joists and rafters, in some instances, to a considerable height, and threw them down on the north side of its path, four hundred yards from the house from which they were taken, almost at right angles to its course, and exactly opposite to the course which the wind must have blown at the ground in the yard, as manifested by the direction in which the trees were lying.

It carried up shingles, boards, hats, books, and branches and leaves of trees, and threw them down on the north side of the spout in a band of several miles wide, terminating on the north east end of Staten Island and fifteen miles from Amboy, where the spout ceased to reach the earth, and twenty-five miles from New Brunswick.

At the time when these materials fell, there fell with them a violent shower of hail and rain, the hail, however, being confined to a few miles in the middle of the band where the heaviest part of the shingles and boards fell.

On each side of this band, particularly on the north, there fell a copious shower of rain, mingled with shingles; and even beyond the

eighteen months after preparation, a strength at least equal to that which they had when upon the tree. This tends to shew that the presence of chloride of calcium does not in any way diminish the strength of the vegetable tissues.

borders of the rain, on the north east, small branches and leaves of trees fell in New York Bay, and in North River, opposite to the city of New York.

There was no rain nor hail on the path of the spout, nor on the south side of it; it began about a mile on the north side, increasing in quantity to the middle of the band where the hail was, and then gradually diminishing again as it approached the northern and eastern boundary.

The spout lasted only for a few seconds in a place, and was immediately before, and after, nearly calm, and its effects were hardly felt a few hundred yards off to either side. The noise which accompanied it was every where described as very alarming, not like any thing heard before, more like the rumbling of a great many carriages than any thing else, or, as one man expressed himself, like an earthquake in the air. In Staten Island, as to the length of time this noise was heard previous to the commencement of the hail and rain, the evidence varies from fifteen minutes to an hour, and as to the length of time the shower was falling, it varies from eight minutes to thirty or forty.

Though there was no rain in the path of the spout, the cloud, or mist, of which it was composed, must have been very humid, as the grave stones at Piscataway were covered on the west side with a coat of mud, and in many places the grass and leaves which lodged in masses on the west side of trees which were left standing were clotted together with mud, as if they had been drifted there by an inundation, and several persons that were caught in the spout were entirely covered with mud, so that they could not be known by their friends. There were some lightning and thunder attending the meteor, but not much unless the continual rumbling, or roar, was produced by it, which is not very likely, as a great many who heard the rumbling did not even see lightning.

The wind, probably in the whole length of the spout, certainly in many places, began to blow on the northern half of the spout from the N. E., and on the southern half of the spout from the S. E.; for materials were found which had been moved in that direction first, and afterwards carried back even beyond their original position by the hinder part of the spout, which appears, in all cases, to have been the strongest. As a proof of this, several places were found where the weak and rotten trees were thrown down by the van of the spout, with the tops of those on the northern side towards the S. W., and the tops of those on the southern side towards the N. W.; while the stronger trees which resisted the first shock were afterwards prostrated by the rear of the spout. And in every case where trees were found lying across each other, which, to a careless observer, might have indicated a whirlwind of confusion, the most perfect regularity was manifested; the strongest trees lying on top, and with their tops pointing inwards and forwards, as mentioned before.

Besides, four different places were found where the tops of all the trees in a circular space, equal in diameter to the breadth of the spout, were thrown inwards towards one common centre. In the middle of one of these stood a large frame house, which had its roof carried

off. The walls of the upper story, both on the north and south side, were cracked; and in one crack was thrust a lady's pocket handkerchief, and in the other a sheet, taken up from a bed in the room, and the cracks closed when they were carried partly through. All the windows in the house were broken, and much of the glass was lying on the outside of the house. The owner of the house is sure all this was done in a second or two of time, and he assured me that the next moment it was as still as death, not enough of air to move the leaves of the trees, which were prostrated all round his house, with their tops against his very door.

In this case the van of the spout appears to have been as strong as the rear, for several out-houses to the east of the dwelling mansion were prostrated, having many of their heaviest materials carried some distance towards the west. Perhaps indeed I was too hasty in drawing the conclusion that the rear of the spout was stronger than the van, from the circumstance that the trees were generally thrown down in the direction of the spout; for if the forces had been *equal*, they might have generally fallen in this direction, from the momentum they would have in this direction in straightening themselves, by their elasticity, at the moment the van passed and the rear came upon them. Notwithstanding, as the wind on that day was from the S. W., this circumstance renders it probable that the rear of the spout was the strongest; for it would appear that the force of the wind, whatever it was, should be added to the rear and subducted from the van.

During the fall of the rain and hail in Staten Island, the wind in the borders of the shower blew in all places from the centre of the shower, very strong in the northern part from the south, variable in the middle, and moderate in the south from the north. And the rumbling noise preceded the fall of the rain at least fifteen minutes at Mussero's ferry, on the very north side of the island. As the time of the shower at this place was certainly, from the evidence, after the spout had disappeared, it seems probable that the spout continued in mid air some time after its disappearance at the surface of the earth.

Was this noise caused by the concussion of the materials, the lighter particles of hail which were then just formed being carried up with great swiftness against the heavier, which at that time might be at their greatest elevation or even beginning to descend; or was it produced by electricity? The height of the spout where it lost itself in the cloud, though it probably rose much higher into the cloud itself, was not very certainly made out.

It is probable, however, from comparing several accounts of the distance at which it was seen, and the angular elevation as near as could be ascertained, that the height was about a mile, or, from the very distinct testimony of Mr. Cole, a little more.

He was standing four and a half miles east of Amboy, beyond which the spout did not reach. He saw a very black column of cloud, about eight times as high as it was broad, rising in the west; lighter clouds on each side of it were "streaming" towards it with great velocity and joining it, but not crossing it. The upper end of

this column was about ten degrees high. The evidence of Mr. Hunt, engineer of the boat Napoleon, is almost exactly similar to Mr. Cole's. He was about seven miles from New Brunswick, and saw the spout before it reached the town. He thinks, however, that the column was only about three times as high as it was broad. After looking at it some minutes, he could plainly see detached pieces of cloud darting inwards and upwards, joining the upper end of the column and losing themselves there, and in five or six minutes more, when the column reached New Brunswick, the materials which had been seen to fly upwards increased in number, and gave the appearance of a volcano; these materials seemed to him to rise three hundred yards. Now as the spout, when first seen by Mr. Hunt, must have been eight or nine miles distant, its height could hardly have been less than a mile.

On this same day three other spouts occurred, about seventeen miles apart, measuring perpendicular to the line of direction of the Brunswick spout. The one next to the Brunswick spout, seventeen miles north, passed through a village in the neighbourhood of Paterson, New Jersey, about three hours after the passage of the spout at Brunswick. It was accompanied by violent hail and rain on the very path of the spout.

On the same day, and afternoon, and night, there was a very great rain in the state of New York, commencing at Schenectady, about three, P. M , with a roaring, of fifteen minutes, like a distant cataract: 2.45 inches of rain fell in Albany, wind N., and much more at Lebanon. And during the whole night of the 19th, there was in the neighbourhood of Amboy a violent S. W. wind and very black clouds coming from the N. E., mingled with a bright silvery light, and most vivid lightning without thunder. The wind below changed about daylight to the N. E., and blew violently very cold for some hours, and then again resumed its old course, S. W., on the afternoon of the 20th.

On this same morning, the 20th, a most violent N. E. gale was experienced at Quebec.

Two conclusions, which promise to be of immense value in meteorology, are clearly deducible from the facts here established.

1. *There was an inward motion of the air in all directions towards the centre of the spout below, and upward motion in the middle.**

2. *The hail was formed by the congelation of drops of rain generated at and over the place where the shingles were taken up.*

Trans. Amer. Philos. Soc.

* The cause of this upward motion in the spout is the great expansion of the air from the evolution of latent caloric, when the vapour in the spout changes to water; the expansion of the air by the liberated caloric being about six times greater than when combined with water in the form of vapour, as has been fully explained in a paper now preparing for insertion in the Transactions of this Society.

Origin of the Mineral Dysodil.

In 1808, Sordier classed this mineral among bituminous substances. It is well known in Sicily, where it is employed as a combustible substance. Ehrenberg, in a paper published last year, demonstrates that this substance, which resembles yellow wax, is formed of the siliceous debris of naviculæ, cemented together by a kind of resin. He shows also that it exists in the collection of Krantz of Berlin, in a lignite of Westerwalde, the colour of which is black, and in which all the microscopic characters of the yellow dysodil of Sicily may be recognised, but with some difficulty, because it is mixed with a considerable quantity of the pollen of pines and other vegetable remnants. Ehrenberg has since found it also in the bituminous foliated coal of Geistinger Busch, near Rott and Siegburg, and also in the foliated lignite of Vogelsberge. He concludes that dysodil is produced by the agglomeration of infusoria, and is obviously a polishing slate, accidentally infiltrated with mineral tar; whilst at Bilin, near Cassel, it is found existing without any mixture of bitumen. Its colour may be yellow, or brown, or black; it occurs generally in extensive beds, and in sufficient quantity to be used for economical purposes.—*Athenæum.*

Mining Jour.

Meteorological Observations for September, 1841.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	64	74	29.80	29.80	W.	Moderate.		Clear—do.
	2	64	82	.80	.82	W.	do.	.17	Lightly cloudy—clear—shower.
	3	68	72	.85	.85	S.	do.	.15	Clear—do.—shower.
	4	72	82	.70	.65	W.	do.	.05	Rain—clear.
	5	64	76	.70	.75	N.	Brisk.		Clear—do.
	6	63	76	.90	.94	N.	Moderate.		Clear—do.
	7	66	72	.96	.90	E.	do.		Cloudy—do.
	8	63	72	.93	.93	E.	do.		Clear—do.
☽	9	58	68	.93	.95	E.	do.		Clear—do.
	10	64	76	30.00	30.00	E.	do.		Cloudy—clear.
	11	60	76	29.90	29.90	SE. W.	do.		Cloudy—lightly cloudy.
	12	66	74	.93	.93	NW.	do.		Cloudy—do.
	13	66	71	.90	.94	SE.	do.		Cloudy—do.
	14	56	72	30.00	30.04	W.	Brisk.		Partially cloudy—clear.
⊗	15	56	72	.15	.15	W. E.	Moderate.		Clear—do.
	16	56	69	.17	.00	E.	do.		Cloudy—do.
	17	58	69	.08	.00	E.	do.	.84	Cloudy—rain.
	18	54	72	29.90	29.90	W.	do.		Clear—do.
	19	56	69	30.00	30.04	NE.	do.		Clear—lightly cloudy.
	20	56	69	.00	.00	E. S.	do.		Foggy—clear.
	21	62	70	.00	.00	E.	do.		Fog—clear.
	22	61	66	29.90	29.80	E.	do.		Cloudy—do.
☾	23	62	68	.75	.70	E.	do.	.07	Partially cloudy—showery.
	24	69	71	.76	.70	S.	do.	.15	Cloudy—showery.
	25	69	69	.55	.55	SW. W.	Brisk.	.03	Cloudy—clear—shower.
	26	54	71	.74	.74	SW.	do.		Clear—do.
	27	54	70	.86	30.00	W. SW.	do.		Clear—do.
	28	62	72	.94	29.83	SE S.	do.		Partially cloudy—cloudy.
	29	67	75	.72	.68	SW.	do.	.32	Showery—flying clouds—rain.
♉	30	54	62	.65	.75	W. NW.	Brisk.		Clear—do.
	Mean	61.47	71.57	29.88	29.88			1.78	

	Thermometer.		Barometer.	
Maximum height during the month,	82.00	on the 2nd and 4th.	30.17	on the 16th.
Minimum " "	54.00	" 18th, 26th, 27th, and 30th.	29.55	" 25th.
Mean	66.35		29.88	

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

NOVEMBER, 1841.

	County.	Town.	Observer.	Thermometer. 7, A.M.	2, P.M.	9, P.M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Mean.	Days omitted.	Barc 7, A.M.	2, P.M.	9, P.M.
1	Philadelphia,	Philadelphia,	E. W. Hamilton,	39.07	51.85	45.80	80.00	22.00	45.57	4⅔	14.00	34.52	3	30.05	29.93	30.01
2	Montgomery,															
3	Bucks,	Newtown,	L. H. Parsons,	35.53	44.31	37.67	72.00	18.00	39.17	⅓	15.50	32.08	..	29.93	29.90	29.92
4	Lehigh,															
5	Northampton,															
6	Monroe	Stroudsburgh,	A. M. Stokes,	35.36	47.00	37.50	65.00	19.00	39.95	22	.....	.....	..	29.53	29.58	29.72
7	Pike,															
8	Wayne,															
9	Susquehanna,	Silver Lake,	E. Rose,	36.33	45.17	39.77	70.00	16.00	40.42	.	16.00	34.40	..	27.95	27.95	27.94
10	Luzerne,															
11	Schuylkill,	Port Carbon	P. Carbon Lyceum,	35.10	44.67	36.50	66.00	18.50	38.76	1⅓	17.00	30.88	1	29.25	29.20	29.25
12	Berks,															
13	Chester,															
14	Delaware,	Haverford,	Haverford School,	38.43	51.19	49.73	64.00	20.00	46.45	1	16.00	33.79	2	29.42	29.38	29.40
15	Lancaster,	Lancaster,	Conservatory of Arts,	38.15	46.59	39.48	72.00	17.00	41.41	⅓	16.00	35.35	..	29.44	29.40	29.42
16	York,															
17	Lebanon,															
18	Dauphin,	Harrisburg,	J. Heisely,	40.33	43.83	42.50	64.00	26.00	42.22	⅔	24.00	37.00	..	29.61	29.68	29.69
19	Northumberland,	Northumberland,	Andrew C. Houston,	36.93	44.17	38.57	69.00	20.00	39.89	.	16.00	32.40	..	29.37	29.34	29.37
20	Columbia,															
21	Bradford,															
22	Tioga,															
23	Lycoming,															
24	Union,															
25	Mifflin,															
26	Juniata,															
27	Perry,															
28	Cumberland,	Carlisle	Prof. W. H. Allen,	35.70	45.14	38.14	70.00	19.00	39.66	1⅙	18.00	32.70	..	29.33	29.33	29.32
29	Adams,	Gettysburg,	Prof. M. Jacobs,	36.97	45.31	39.17	67.00	19.00	40.48	.	19.00	35.27	..	29.32	29.28	29.31
30	Franklin,															
31	Huntingdon,	Huntingdon,	Prof. Jacob Miller,	35.07	46.21	40.43	74.00	22.00	40.27	1	.....	.....	..	29.26	29.32	29.30
32	Centre,	Bellefonte,	John Livingston,	37.02	45 73	39.27	72.00	22.00	40.67	.	.....	.....	..	29.10	29.12	29.16
33	Potter,															
34	M'Kean,															
35	Clearfield,															
36	Cambria,	Ebensburgh,	Richard Lewis,	31.83	38.40	32.14	68.00	14.00	34.12	2⅓	14.00	29.90	..	27.73	27.74	27.75
37	Bedford,	Bedford,	Samuel Brown,	35.95	45.60	39.28	72.50	14.00	40.28	⅔	.....	.....	..	29.15	29.12	29.13
38	Somerset,															
39	Indiana,															
40	Jefferson,	Punxsutawny,	J. Smith	29.57	42.03	31.67	75.00	17.00	34.42	.	.....	.....	..	28.87	28.82	28.84
41	Warren,															
42	Venango,	Franklin,	Wm. Connely,	34.63	44.57	37.20	74.00	32.00	38.80	.	.....	.....	..	29.02	29.03	29.04
43	Armstrong,															
44	Westmoreland,															
45	Fayette,															
46	Green,															
47	Washington,															
48	Alleghany,	Pittsburgh,	J. P. Bakewell,	46.55	45.74	48.07	70.00	35.00	46.79	1⅓	25.00	37.00	1	29.15	29.15	29.16
49	Beaver,															
50	Butler,	Butler,	Jacob Mechling,	40.00	44.07	40.33	79.00	26.00	41.47	.	.....	.....	..	28.72	28.72	28.72
51	Mercer,															
52	Crawford,	Meadville,	Henry Shippen,	34.43	40.73	33.97	72.00	21.00	36.38	.	22.00	33.00	..	28.64	28.66	28.65
53	Erie,															

Days omitted.	Barometer.							Weather.							Wind									
	7, A.M.	2, P.M.	9, P.M.	Maximum.	Minimum.	Mean.	Days omitted.	Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers	Rain in inches.	North.	N.N.E.	N.E.	E.N.E.	East.	E.S.E.	S.E.	S.S.E.	South.	S.S.W.
3	30.05	29.93	30.01	30.58	29.59	30.00	3⅔	19⅓	7	3⅔	13	4	.....	..	4.041	2	.	3⅔	⅓	⅔	.	⅓	⅔	1	.
..	29.93	29.90	29.92	30.48	29.44	29.92	⅓	12⅓	15	2⅔	12	4	.....	..	3.773	1⅓	.	4⅓	⅓	.	⅓	⅔	⅔	.	1
..	29.53	29.58	29.72	29.88	29.20	29.61	22⅔	2⅔	4⅓	23	.....	.....	.....	..	.....	⅓	.	⅔	.	1	.	⅓	.	.	.
..	27.95	27.95	27.94	28.30	27.51	27.95	.	5	25	.	2	4	.....	..	.....	5	.	4	.	.	.	.	.	4	.
1	29.25	29.20	29.25	29.73	28.80	29.23	1⅔	7⅓	20⅔	2	7	4	1	.	2.294	⅓	.	2	.	2⅓	.	3	.	⅔	.
2	29.42	29.38	29.40	29.94	28.96	29.40	1⅓	11	17⅔	1⅓	11	2	.....	..	4.256	4⅓	⅓	1⅓	⅔	.	.	•	.	⅓	
..	29.44	29.40	29.42	29.96	28.90	29.42	⅔	13⅔	16	⅓	8	5	.....	..	3.127	3⅓	1⅓	2⅔	1	⅔	⅓	⅓	⅓	3	1
..	29.61	29.68	29.69	30.17	29.31	29.66	⅓	.	.	.	9	2	1	..	....	1	.	2	.	3	.	3⅓	.	.	.
..	29.37	29.34	29.37	29.88	28.90	29.36	.	5⅔	24⅓	.	8	2	1	..	2.412	3⅓	.	2⅔	.	2⅓	.	2	⅓	4	.
..	29.33	29.33	29.32	29.82	28.87	29.33	1⅓	6	22⅔	1⅓	6	5	.....	..	3.052	1⅓	.	1⅔	.	1	.	⅓	⅓	1⅔	
..	29.32	29.28	29.31	29.74	28.83	29.30	.	9⅓	20⅔	.	8	3	4	..	3.725	⅔	⅓	2⅔	1⅓	.	⅔	.	.	2⅔	2
..	29.26	29.32	29.30	29.73	28.82	29.29	1	8⅓	20⅔	1	9	3	.....	..	2.377	.	.	.	.	8/10	.	.	.	.	.
..	29.10	29.12	29.16	29.69	28.00	29.13	.	5	25	.	7	2	1	..	3.173	4	.	1	.	5/10	.	⅓	.	2⅔	.
..	27.73	27.74	27.75	28.10	27.38	27.74	2⅓	4	23⅔	2⅓	7	4	.....	1	3.369	.	.	.	.	5	.	2	.	.	.
..	29.15	29.12	29.13	29.55	28.80	29.13	⅓	7	22⅔	⅓	.....	.....	.....	..	.....	.	.	⅓	.	2	.	2⅓	•	2 5/10	.
..	28.87	28.82	28.84	29.20	28.40	28.84	.	5⅔	15⅔	8⅔	8	8	1	..	.....	.	.	.	.	.	.	.	.	.	.
..	29.02	29.03	29.04	29.60	28.52	29.03	.	.	.	.	7	5	.....	..	2.072	.	.	.	.	.	.	5	.	.	.
1	29.15	29.15	29.16	29.52	28.65	29.15	1	4⅔	24⅓	1	8	.....	.....	..	2.764	.	.	1	⅓	1	⅔	3⅓	.	⅓	.
..	28.72	28.72	28.72	29.10	28.30	28.72	.	.	.	.	5	3	3	1	3.615	.	.	5/10	.	7⅔	.	2⅔	.	⅔	.
..	28.64	28.66	28.65	29.05	28.20	28.65	.	4	24⅓	1⅔	5	3	.....	2	3.230	1⅔	.	1	.	1⅔	.	1⅔	.	8⅔	.

Winds.												Hygrometer.					
S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point	Wet Bulb.	Days omitted.	No. of Report.
⅔	1	.	2⅔	⅓	5½	⅓	4	1⅓	.	7⅓	....	.	.....	....	..	1782
⅔	.	1	4	1	3⅓	1⅓	9⅔	.	.	2	....	.	.....	....	..	1718
.	.	.	⅔	.	3	.	⅔	.	.	23½	....	.	.....	....	..	1651
.	4	.	2⅔	.	5⅓	.	8⅓	.	.	.	....	.	.....	....	..	1652
.	⅔	.	3	.	4	.	6	.	7⅓	1⅓	....	.	.....	....	..	1667
.	⅓	⅓	⅓	⅔	3	⅓	⅔	1	⅓	16⅓	....	.	.....	....	..	1642
⅓	3	1	2⅓	3	3	4⅓	1⅓	1⅓	.	⅓	37.26	1	.....	42.76	1	1657
.	.	.	1	.	4⅔	.	14⅔	.	.	⅓	....	.	.....	....	..	1630
⅓	4	.	1⅔	.	6⅓	⅓	4	⅓	2⅔	.	....	.	.....	....	..	1631
⅓	⅔	1⅔	⅔	4	.	3	.	8⅔	.	6⅔	1⅓	....	.	.....	....	..	1649
.	.	2⅔	2⅔	1⅓	1	6⅓	2	3⅔	1	3⅓	⅔	35.47	8	.....	42.94	7	1655
.	.	.	.	.	.	20⅔	.	.	.	.	1	....	.	.....	....	..	1656
⅓	.	2⅔	.	3	.	6⅔	.	9⅔	.	.	2⅓	....	.	.....	....	..	1640
2	.	.	.	1⅔	⅓	13	⅔	4⅓	.	⅓	2⅓	....	.	.....	....	..	1647
2⅓	.	2⅓	.	7	⅔	1⅔	7	6⅓	.	.	⅓	....	.	.. .	....	..	1632
.	.	.	.	.	.	.	.	.	.	.	.	....	.	.....	....	..	1658
5	.	.	.	9⅓	.	.	.	15⅔	.	.	.	....	.	.....	....	..	1646
3⅓	.	⅓	.	1	.	2	1⅔	7⅓	.	10⅓	1	....	.	.....	....	..	1637
2⅔	.	⅔	.	6	.	12⅔	.	.	.	.	.	....	.	.....	....	..	1644
1⅔	.	8⅔	.	⅔	.	4	.	⅓	.	9⅓	1	....	.	.....	...	..	1641

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